(2)

UNITED STATES ARMY BIOMEDICAL RESEARCH & DEVELOPMENT LABORATORY

ANNUAL PROGRESS REPORT
1 October 1989 - 30 September 1990

FORT DETRICK, FREDERICK, MD 21702-5010

ANNUAL PROGRESS REPORT
1 October 1989 - 30 September 1990

THIS PAGE INTENTIONALLY LEFT BLANK.

U.S. ARMY BIOMEDICAL RESEARCH AND DEVELOPMENT LABORATORY,
ANNUAL PROGRESS REPORT FY90

U.S. ARMY BIOMEDICAL RESEARCH AND DEVELOPMENT LABORATORY
FORT DETRICK
FREDERICK, MARYLAND 21702-5010

1 January 1991

Annual Progress Report for Period 1 October 1989 - 30 September 1990

U.S. ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND
FORT DETRICK
FREDERICK, MARYLAND 21702-5012

NOTICE

Disclaimers

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Citations of commercial organizations or trade names in this report do not constitute an official Department of the Army endorsement or approval of the products or services of these organizations.

Research was conducted in compliance with the Animal Welfare Act, and other Federal statues and regulations relating to animals and experiments involving animals and adheres to principles stated in the Guide for the Care and Use of Laboratory Animals, NIH publication 86-23, 1985 edition.

Disposition

Destroy this report when it is no longer needed. Do not return it to the originator.

Accession For	
NTIS GRA&I	☑
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for Public Release; Distribution Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Biomedical Research and Development Laboratory 6b. OFFICE SYMBOL (If applicable) SGRD-UBZ	7a. NAME OF MONITORING ORGANIZATION U.S. Army Medical Research and Development Command
6c. ADDRESS (City, State, and ZIP Code) Fort Detrick Building 568 Frederick, MD 21702-5010	7b. ADDRESS (City, State, and ZIP Code) Fort Detrick Building 504XX Frederick, MD 21702-5012
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Medical Research & Development Command 8b. OFFICE SYMBOL (If applicable) SGRD-ZA	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Fort Detrick Building 504XX Frederick, MD 21702-5012	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO.: See Reverse PROJECT NO.: See Reverse TASK NO.: See Reverse WORK UNIT ACCESSION NO.: See Reverse
11. TITLE (Include Security Classification) (U) U.S. Army Biomedical Research and Development Laboratory, Annual Progress Report FY90	
12. PERSONAL AUTHOR(S) STEPHEN C. HEMBREE, Ph.D., Colonel, MS, Commanding	
13a. TYPE OF REPORT Annual Progress 13b. TIME COVERED FROM 1 Oct 89 TO 30 Sep 90	14. DATE OF REPORT (Year, Month, Day) 1991 January 1 15. PAGE COUNT 271
16. SUPPLEMENTARY NOTATION	
17. COSATI CODES FIELD / GROUP / SUB-GROUP	18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Aquatic Toxicology, Aquatic Microcosm, Biochemical Toxicology, Carcinogenicity Research, Reproductive Effects Research, Toxin Decontamination, Biological Warfare, (cont)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Annual Progress Report, Fiscal Year 1990, summarizes the research performed by the U.S. Army Biomedical Research and Development Laboratory in projects authorized by the U.S. Army Surgeon General and the Commander, U.S. Army Medical Research and Development Command. This research was supported by RDTE funds from the U.S. Army Medical Research and Development Command, and as reimbursables from the U.S. Army Corps of Engineers, and from several additional sources.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION
22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code) / 22c. OFFICE SYMBOL

Block 10

EXTRAMURAL	IN-HOUSE
000000 000000000000.00.001	61102A 4E161102BS04.AA.002
000000 000000000000.00.002	61102A 4E161102BS04.AA.003
61102A 4E161102BS04.AA.042	61102A 4E161102BS04.AA.004
61102A 4E161102BS04.AA.043	61102A 4E161102BS04.AA.005
61102A 4E161102BS04.00.044	61102A 4E161102BS04.AA.008
61102A 3M161102BS15.CC.071	61102A 4E161102BS04.AA.009
61102A 3M161102BS15.CC.073	61102A 3M161102BS12.AA.033
65502A 3P665502M802.CA.161	61102A 3M161102BS12.AA.035
65502A 3P665502M802.CA.162	61102A 3M161102BS13.AS.001
65502A 3P665502M802.BA.163	61102A 3M161102BS15.CC.006
65502A 3P665502M802.BA.165	61102A 3M161102BS15.AA.007
65502A 3P665502M802.BA.166	64807A 3S464807D832.AL.001
65502A 3P665502M802.BA.168	64807A 3S464807D832.AK.002
65502A 3P665502M802.BA.171	64807A 3S464807D832.CH.003
65502A 3P665502M802.BA.174	64807A 3S464807D832.AI.004
65502A 3P665502M802.BA.203	64807A 3S464807D832.A2.008
65502A 3P665502M802.CA.207	64807A 3S464807D832.A2.009
62787A 3M162787A825.KA.126	64807A 3S464807D832.A2.010
62720A 3E162720A835.00.001	64807A 3S464807D832.CH.043
62720A 3E162720A835.00.004	62720A 3E162720A835.AA.121
62720A 3E162720A835.C2.005	62720A 3E162720A835.AA.122
62720A 3E162720A835.00.006	62720A 3E162720A835.AA.123
62720A 3E162720A835.00.007	62720A 3E162720A835.AA.126
62720A 3E162720A835.00.008	62720A 3E162720A835.AA.129
62720A 3E162720A835.00.009	62720A 3E162720A835.AA.130
62720A 3E162720A835.00.010	62720A 3E162720A835.AA.131
62720A 3E162720A835.00.011	62720A 3E162720A835.AA.132
62720A 3E162720A835.C1.012	63807A 3M463807D836.KE.002
62720A 3E162720A835.C1.013	63807A 3M463807D836.KD.003
62720A 3E162720A835.00.014	63002A 3M263002D840.AE.051
62720A 3E162720A835.00.015	63002A 3M263002D840.AE.053
62720A 3E162720A835.00.016	63002A 3M263002D840.HZ.054
62720A 3E162720A835.00.018	63002A 3M263002D840.AE.055
62720A 3E162720A835.00.019	63002A 3M263002D840.MA.056
62720A 3E162720A835.00.020	64807A 3S464807D848.CB.051
62720A 3E162720A835.00.022	64807A 3S464807D848.BL.052
62720A 3E162720A835.AA.023	64807A 3S464807D848.CE.053
62720A 3E162720A835.00.024	62787A 3M162787A870.AV.264
62720A 3E162720A835.00.025	62787A 3M162787A870.AV.266
62720A 3E162720A835.00.026	62787A 3M162787A874.BA.224
62720A 3E162720A835.00.027	62787A 3M162787A874.BA.227
62720A 3E162720A835.00.030	62787A 3M162787A874.BA.229
62720A 3E162720A835.00.031	62787A 3M162787A874.MA.232
62720A 3E162720A835.00.036	62787A 3M162787A875.CG.224
62720A 3E162720A835.00.056	62787A 3M162787A875.AG.229
62720A 3E162720A835.00.057	62787A 3M162787A878.CA.242
63002A 3M263002D840.AE.027	62787A 3M162787A878.CA.246
62787A 3M162787A875.AG.262	62787A 3M162787A878.CA.247
62787A 3M162787A875.AF.263	62787A 3M162787A878.CA.248
62787A 3M162787A878.CA.287	62787A 3M162787A878.CA.249
62787A 3M162787A878.CA.293	62787A 3M162787A878.CA.250
62787A 3M162787A878.C1.315	62787A 3M162787A878.CA.252

UNCLASSIFIED

Block 10, Continued
IN-HOUSE

62787A 3M162787A878.CA.253
62787A 3M162787A878.CA.254
62787A 3M162787A878.CA.255
62787A 3M162787A878.CA.256
62787A 3M162787A878.CA.257
62787A 3M162787A878.CA.258
62787A 3M162787A878.CA.259
62787A 3M162787A878.AV.261
63807A 3M463807D993.CD.081

Block 18. Continued

Vector Control, Toxicology, Occupational Health and Exposure Assessment, Health Effects Test Methodology, Alternative Test Methods, In Vitro Test Methods, Cell Cultures, Oncogene, Biomarkers, Environmental Hazards Assessment, Photochemistry, Environmental Quality, Pesticide Dispersal, Medical Imaging, Combat Medicine, Nerve Agents, Industrial Hygiene Sampling, Microbiology, Combustion Products, Liquid Gun Propellant, Organic Chemistry, Inorganic Chemistry, Radiographs, Field Medical Materiel, Field Sterilizers, Sterilization, Ecological Effects, Drinking Water Quality, Weapons Health and Performance Effects, Filmless Radiography, Water Quality Standards, Health Advisories, On-Site Biomonitoring, Disinfectants, Field Water Quality, IV Fluids, Demand Oxygen Controller, Special Operations Forces Medical Materiel, Surgical Scrub Sink, Cricothyroidotomy, Far-Forward Surgical Care, Multi-Frequency Jet Ventilation, Far-Forward X-Ray Film Developing, Mass Casualty Triage Lighting, Resuscitation/Ventilation, Decontaminable Litter, Chemical Defense Materiel, Vital signs Monitor, Wound Lavage, Life Detector, Drawover Anesthesia Device, Arthropod Repellents.

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK.

INTRODUCTION

The U.S. Army Biomedical Research and Development Laboratory (USABRDL) is a subordinate unit of the U.S. Army Medical Research and Development Command (USAMRDC) located at Fort Detrick, Frederick, Maryland. It has a multi-disciplinary staff of 120 authorized scientists, engineers, artisans, technicians, and support personnel, 80 percent of whom are civilian. Its budget for FY90 was almost 13 million dollars, combining direct and reimbursable funding and contract funding applied to the mission by Headquarters, USAMRDC.

The USABRDL conducts research for the soldier. It contributes to readiness directly by products developed and by knowledge it generates for protection of troop health. It contributes to readiness indirectly by providing data that guide environmental hazard minimization and hazardous waste site cleanup at tremendous cost savings. The three divisions of the Laboratory are organized along functional lines corresponding to missions.

Health Effects Research Division (HERD) performs environmental and occupational health research of vital interest to both military and civilian sectors. These missions are driven by an extensive body of Public Law, Department of Defense Directives, and Army Regulations. Such mandates reflect intense concern of National leadership for environmental and occupational health issues and dedication of Army leadership to protecting the environment, military personnel, and affected civilian populations from potentially hazardous effects of military materiel and activities. Health Effects Research Division contains an Environmental Quality Research Branch, an Occupational Health Research Branch, and a Research Methods Branch.

Field Medical Materiel Development Division (FMMDD) functions in two distinctive but related mission areas oriented strongly toward preservation of fighting strength. Combat Casualty Care Branch performs research, development, test, and evaluation (RDTE) of medical materiel primarily for use in forward areas of the combat zone, in evacuation, and for unconventional warfare. Military Disease Hazards Branch performs RDTE for control of arthropod-borne diseases, to include equipment and materials and concepts and methods for their effective use. Industrial services for construction of prototype items, limited-scale manufacturing, and administration specifically related to materiel acquisition are indigenous to this Division.

Laboratory Support Division (LSD) contains centralized administrative and support functions common to the entire organization and the Technical Services Branch that does engineering evaluations, technical testing, and first article testing as required.

Stephen C. Hembree

STEPHEN C. HEMBREE, Ph.D.
Colonel, MS
Commanding

DESCRIPTION OF USABRDL

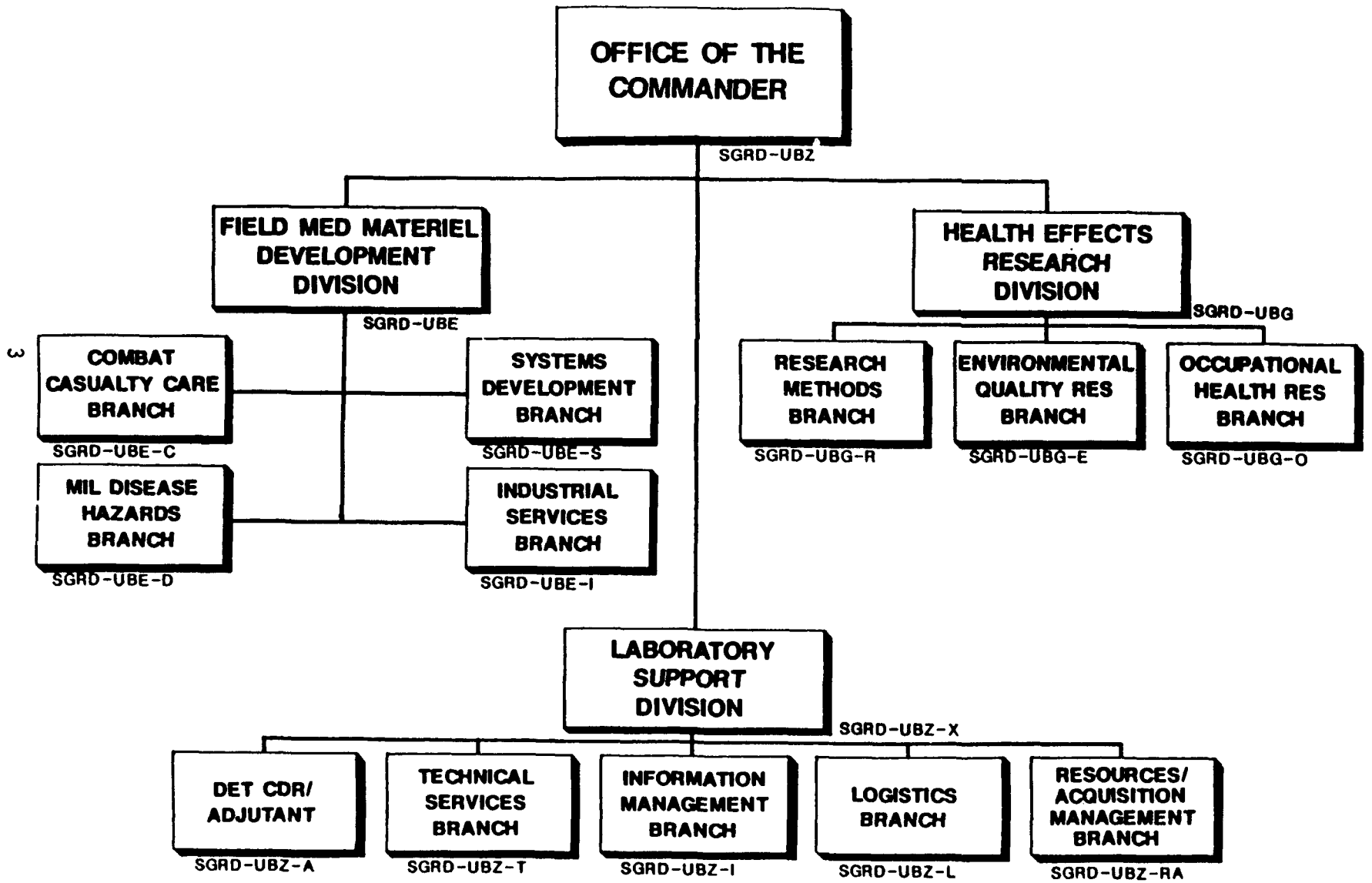
LABORATORY MISSION

The U.S. Army Biomedical Research and Development Laboratory conducts basic research in the areas of field medical materiel, vector control systems, health hazard assessments, and environmental health effects. It also develops or modifies, tests, and evaluates field medical, dental, and water treatment equipment and technologies and develops vector control and field sanitation methods, materials, and equipment to meet military needs; establishes atmospheric and water related health hazard databases for occupational and field exposures to chemicals and microorganisms; provides exposure guidance and recommends criteria and develops and recommends environmental criteria and pollution abatement procedures for chemical substances from Army industrial and field operations. In addition, USABRDL provides research, consultation, and technical services to the Army and other Federal agencies as requested.

ORGANIZATION CHART

U S ARMY BIOMEDICAL RESEARCH & DEVELOPMENT LABORATORY

FORT DETRICK, FREDERICK, MARYLAND 21702-5010



STAFFING

The USABRDL operated with an authorized staff of 120 professional, technical, and support personnel representing a wide range of scientific, administrative, and engineering disciplines, experienced in both in-house and extramural research management, and supported by state-of-the-art laboratory equipment. The USABRDL provides unique capabilities for support of Army research activities in the broad areas of combat casualty care, human health effects of environmental pollution, preventive medicine, and medical aspects of chemical defense.

Professional disciplines represented in the organization include:

Aquatic Biology
Biology
Biomedical Maintenance
Biostatistics
Chemistry
Computer Science
Drafting
Engineering
Entomology
Environmental Sciences
Library Science
Medical Illustration
Medical Technology
Microbiology
Nursing
Occupational Health
Pharmacology
Physiology
Safety
Toxicology
Trades and Crafts

TABLE 1. USABRDL FY90 STAFFING

	Required	Authorized
Officer	14	13
Enlisted	15	14
Civilian	127	93*
TOTAL	156	120

* Includes four full-time temporaries.

MEDICAL ADVISOR FOR CLINICAL, OCCUPATIONAL, AND ENVIRONMENTAL HEALTH

Authorization to assign a physician in the Office of the Commander was granted by the USAMRDC within the last year. Specific functions of the position include responses to the Commander concerning a variety of health and safety related issues. Internal coordination of sensitive medical issues concerning early stage developmental items and health related research in occupational/environmental health has been an integral functional requirement. Liaison, coordination, and special issue assignments with the U.S. Army Major Commands and the Office of The Surgeon General (OTSG) have been routinely provided upon request. The Medical Advisor has been assigned as Chairman of the Safety Committee and the Animal Care and Use Committee and identified as Quality Assurance Coordinator and Chemical Hygiene Officer for the Laboratory. He has actively participated in approved research as both Contracting Officer's Representative and Principal Investigator. He has provided training for the Laboratory; the Fort Detrick Health Clinic; the Field Safety Activity; the U.S. Army Chemical Research, Development, and Engineering Center; and several OTSG-sponsored courses. He has provided health care services to Federal employees and dependents at the U.S. Army Health Clinic, Fort Detrick. He has been assigned the position of Adjunct Assistant Professor at the Uniformed Services University of the Health Sciences where he provided classroom instruction in several courses.

QUALITY ASSURANCE

Programmatic management of quality assurance was assigned to the Medical Advisor for Clinical, Occupational, and Environmental Health, Office of the Commander. Changes in participating personnel and committee structure have been made. Re-evaluation of each programmatic element has been directed by the Commander to assure compliance with the spirit and intent of legal and regulatory requirements. Comprehensive internal review of all requirements has been initiated; and revision of procedural documentation to assure compliance consistent with the size, mission, and internal capabilities of the Laboratory has been initiated. Administrative and clerical support have been provided by the Resources/Acquisition Management Branch to assure appropriate documentation and filing. Specific guidelines for credentials review, principal investigator assignment, risk assessment/management, and quality assurance criteria/documentation are currently being prepared for draft review/comment. Milestones for documentation, review, and implementation, and program review procedures are currently being developed.

The written agreement between the Laboratory and the U.S. Army Medical Research Institute of Infectious Disease concerning animal use dates from 1986 and has been submitted for current review. A comprehensive plan to assure appropriate risk management will be developed and implemented. The Laboratory has initiated internal actions to assure effective coordination between internal management offices and to enhance communication with higher headquarters.

SAFETY

Safety Program: The comprehensive USABRDL Safety and Occupational Health Program is formally published as USABRDL Memo 385-1. The Program is specifically tailored to the Laboratory to ensure compliance with all legal requirements of the Occupational Safety and Health Administration and all regulatory requirements of the Department of Defense and the Department of the Army. Specific program objectives are: (a) to provide a safe and healthful workplace within USABRDL for all employees and (b) to maintain effective support for safety at all management levels within the Laboratory.

Progress and Accomplishments: The functional description of the Safety Manager was carefully evaluated, and essential performance requirements were clarified in accordance with legal and regulatory requirements. Based upon prior performance, the management classification was re-evaluated and found consistent with a GS-11 rating. A GS-11 rating was awarded, and the organizational structure was modified to incorporate safety management within the Office of the Commander.

Specific goals and objectives were identified for programmatic direction, and the civilian work plan was revised to assure an overall effective and efficient management strategy. Documentation procedures of the safety program were revised to assure compliance, and a formal reporting format for notification of the Commander concerning safety problems and initiatives was initiated. Hazard Communication and Laboratory Hazard Communication training were provided and documented for all Laboratory employees. The hazard communication program for the Laboratory was revised, and development of a chemical hygiene plan was initiated. An overall evaluation of the safety program was performed by the USAMRDC Safety Office with minor deficiencies noted. As documented evidence of command support, the safety manager was able to maintain a high uniform standard of quality of personal protective equipment provided to all employees with identified job hazards. As a participant in the Fort Detrick hazardous materials management program, the USABRDL Safety Manager has conformed to installation requirements.

FUNDING

Fiscal year 90 began under a Continuing Resolution Act which was extended through January. In March, turmoil was brought about by the uncertainty of a spending freeze in acquisitions. Both budgetary exercises caused havoc with the execution and disbursement targets for the Laboratory. In May 1990, the Internal Review team from USAMRDC visited USABRDL. The budget area once again received the highest possible rating (no findings) during the period. At year-end, the obligation rates for direct and reimbursable funds were 99.96 percent and 100 percent respectively. The overall Laboratory disbursement rate for direct funds was 77 percent which exceeded the 51 percent target set by the Command.

During FY90 unfilled customer orders were a major issue. Budgets were being cut by the Office of the Secretary of Defense (OSD) during budget reviews because OSD's perception is that orders placed at laboratories had been budgeted for more than a 12-month increment resulting in excessive amounts of reimbursable carry-over. In order to avoid reductions during budget reviews due to carry-over orders, RDTE activities were to adhere to policies on reimbursable orders in Army Regulation 37-1. One of these policies is the performing activity will accept direct fund cites in lieu of reimbursables if 85 percent of the order is not an in-house effort or if 15 percent or more is contracted. This policy affected this Laboratory mostly in the area of accepting the Corps of Engineers funding, and next year will affect work orders.

TABLE 2. USABRDL FY90 OPERATING BUDGET

Funding Source and RDTE Project Category	Total FY90 Budget ($000)	
	Intramural	Extramural
1. USAMRDC Core Program		
a. 6.1 91C	58	-0-
6.1 Basic Research	649	140
b. 6.2 Exploratory Research	1,518	235
6.2 Maintenance and Administration	1,342	-0-
c. 6.3 Advanced Development	541	-0-
d. 6.4 Engineering Development	407	-0-
e. 6.5 Management and Support	-0-	1,446
SUBTOTAL	4,515	1,821
2. Reimbursable		
a. Corps of Engineers	1,768	2,446*
b. Other	321	1,347
SUBTOTAL	2,089	3,793
TOTAL CORE AND REIMBURSABLE	6,604	5,614

* Funds for direct fund cites.

FACILITIES

The mission of USABRDL is accomplished in nine buildings. A number of construction and renovation projects were initiated in FY90 to improve the operational efficiency of the facilities. Building 568, which was built as a laboratory in 1952 and currently houses the Office of the Commander and elements of all divisions, underwent numerous changes. Room 112 was renovated for use as a metabolic laboratory while room 122 was renovated and devoted to oncogenic research and biochemical/molecular toxicology. The illustration/photography laboratory relocated from building 568 to building 1056. This move made additional space available for use by the Information Management Branch. Projects in progress include replacing the present duct system of a number of biological safety cabinets with a noncombustible system in compliance with regulations; performing safety and preventive maintenance in the molecular biology laboratory; removing an obsolete tank system which occupies approximately 4,000 square feet of floor space; and constructing laboratory/administrative offices in its place.

A number of projects have been submitted for Building 459, one of HERD's facilities, constructed in 1945. They include replacement of an external exhaust biological safety cabinet for use in work with microorganisms and organic compounds and solvents; construction of a chemical storage facility for storage of mission essential organic chemicals; constructing an addition to the building to provide storage for special projects and equipment; replacing copper drain lines and traps with plastic ones to reduce frequent costly repairs and disruption of ongoing research. Future plans for building 459 include replacement of floor tiles and modification of several rooms.

Building 1054, built in 1954 as an RDTE shop, houses the Industrial Services Branch of FMMDD; Logistics Branch, Technical Services Branch, and the Library of LSD; a small number of personnel from HERD; and a computer system and staff from Headquarters, USAMRDC. Improvements made this year were the replacement of all exterior windows, which greatly improved lighting and insulation; renovation of the chemical lab and unit processing lab office; installation of carpet and modular furniture in the Library. Scheduled additions include installing an environmental chamber required to support repellent research, installing an automatic sprinkler system and noncombustible partitions in the industrial area, and applying interior paint.

Building 1056, built in 1975 as an engineering evaluation and durability testing center for pesticide dispersal equipment proposed for military use and for FMMDD equipment storage, will undergo modification of one of its rooms into an aerosol experimentation laboratory. A portion of the building was renovated and converted into the illustration/photography laboratory.

Building 524, built in 1945, houses HERD's administrative personnel. Building 1053, medical display/storage facility, built in 1987, had "bird excluding" modifications made to the overhead doors. Building 1058, storage facility, built in 1975, and building 1059, a technical services and test facility, built in 1986, were unaltered.

BUILDING SPACE (SQUARE FOOTAGE)

BUILDING	ADMIN	LAB	OTHER	TOTAL
459	1,118	8,793	249	10,160
524	4,877		471	5,348
568	11,055	29,982	8,241	49,278
1053	5,200			5,200
1054	7,413	29,083	501	36,997
1056		3,206		3,206
1058	1,612			1,612
1059		1,560		1,560
1215	120			120
TOTALS	31,395	72,624	9,462	113,481

THIS PAGE INTENTIONALLY LEFT BLANK.

DIVISION ACTIVITIES

LABORATORY SUPPORT DIVISION

RESOURCES/ACQUISITION MANAGEMENT BRANCH

The Resources/Acquisition Management Branch (RAMB) was created during FY89 by consolidating the functions of the Resource Management Branch with those of the Acquisition Management Liaison Office (AMLO). The RAMB was formed to bring responsibility for financial management of the combined program under one office. The Branch is organized into three sections: acquisition management, financial management, and manpower/personnel management. In addition to these operating sections, the Chief, RAMB, has been designated the Laboratory's internal control coordinator and as the representative, research and technology applications (technology transfer).

Acquisition Management: The Acquisition Management Section serves a dual role. It is the hub of the entire contract program, providing a single point of control, information, and policy formation for the Commander. It also serves to support the Contracting Officer's Representatives (CORs) in preparing contract documentation, monitoring receipt of deliverables, and maintaining COR files. Proposals are received in the RAMB and sent to the appropriate division for review. Based upon that review, a proposal is either rejected or documentation is prepared to recommend funding or to obtain a revised proposal. If the responsible branch chief has not already done so, the RAMB will coordinate with the appropriate research area director at the USAMRDC regarding funding. Once the contract is in place, all deliverables are sent to the RAMB. Progress reports are reviewed to determine if administrative problems exist, and appropriate action is taken. The CORs are notified of delinquent deliverables and requested to contact the contractor to expedite delivery. Once a deliverable is received, it is sent to the COR for review; and based upon that review the deliverable is either accepted or returned to the contractor. In the case of reports, a copy is placed in the COR file. The RAMB is also responsible for scheduling necessary training for the CORs.

Progress and Accomplishments: The total extramural budget for FY90 was $5,614K, only 7 percent of which was provided by the Research Area Directorates compared to 22 percent in FY89. The Corps of Engineers provided $2,446K for contracts during FY90. These funds were accepted as direct fund citations due to a policy being enforced stating that the performing activity will accept direct fund cites in lieu of reimbursables if 85 percent of the order is not an in-house effort or if 15 percent or more is contracted. By using the direct fund cites, the tracking of these documents was extremely difficult. The accountability had been taken away from the Laboratory because the obligation and disbursement information no longer went through the financial records at Fort Detrick.

Financial Management: The Financial Management Section coordinates budget preparation and execution, directs activities of the Program Budget Advisory Committee, and manages financial accounting through the Standard Finance System and the Financial Manpower Accounting System. It also provides centralized travel services, other than preparation of travel vouchers. The financial management section reviews budgets submitted by program managers to ensure that all projected costs are budgeted, then monitors the execution of the program to identify problem areas and reports these problems to Laboratory management for resolution.

Progress and Accomplishments: The total funding for the Laboratory in FY90 was $12,814K. This included $6,675K of in-house funds, $3,168K of USAMRDC extramural funds, and $2,971K of direct fund citations from the Corps of Engineers, U.S. Army Medical Materiel Agency and U.S. Army Toxic and Hazardous Materials Agency (DERA funds). The in-house funds consisted of $4,415K direct FY90 funds, $71K direct FY89 carry-over funds, and $2,089K were reimbursable funds. The obligation rates were 99.96 percent and 100 percent for direct and reimbursable funds respectively. The disbursement rates were 77 percent and 75 percent for direct and reimbursable funds respectively which exceeded the target of 51 percent. In FY90, $174K was obligated for travel. Of this, 60 percent was obligated by the Health Effects Research Division, 27 percent by the Field Medical Materiel Development Division, and the remaining 13 percent by the Laboratory Support Division and the Office of the Commander.

Manpower/Personnel Management: The Manpower/Personnel Management Section manages the Table of Distribution and Allowances, initiates all civilian personnel actions for Laboratory personnel, and coordinates all civilian and military training. Close liaison is maintained with both the Civilian Personnel Office, Fort Detrick, and the Headquarters, USAMRDC.

Progress and Accomplishments: The total authorized positions at the end of FY90 were 120, including 13 officers, 14 enlisted, 89 full-time permanent civilians, and 4 full-time temporary civilians. Seven new temporary civilian overhire positions were justified and approved for FY90. The hiring of temporary overhires, and personnel under programs such as summer hires, summer faculty, student volunteers, and personal services contract students proved to be very beneficial for the Laboratory to carry out its mission.

Technology Transfer: The thrust of the technology transfer program is to ensure that new technologies developed within the USABRDL are made available to the commercial sector to be developed for use by the civilian community.

Progress and Accomplishments: One patent for the semi-micro manipulator was awarded, and one patent application was filed for the surgical table during FY90. Five invention disclosures were filed also. A Cooperative Research and Development Agreement between USABRDL and the 3M Company was implemented. Two meetings of the Federal Laboratory Consortium were attended by USABRDL's Technology Transfer Coordinator.

Internal Controls (IC): The Army has an IC program designed to prevent fraud, waste, and abuse and to monitor compliance with Army policies in certain administrative functions. The core of this program is a series of checklists developed by functional managers at Department of the Army level.

Progress and Accomplishments: During FY90, the IC Coordinator reviewed 86 checklists on the Management Control Plan received from USAMRDC. Of those checklists, 20 were selected and forwarded to the appropriate Laboratory personnel. A total of 16 checklists were completed and no material weaknesses were found. Also, 14 positions were identified and approved by the Commander as having internal control responsibilities. These positions will require a statement reflecting these responsibilities in either the civilian performance plan or the military Officer Efficiency Report support form.

DETACHMENT COMMANDER/ADJUTANT

Some 36 basic administrative and management tasks fundamental to successful and legal operations of the Laboratory are performed by the Detachment Commander/Adjutant's office. Of particular importance are those tasks performed on behalf of assigned military personnel. Command responsibilities are exercised for enlisted personnel, including reenlistment, training, and military-unique programs such as weight control.

The Adjutant's office prepared the Laboratory's Master Calendar; prepared and published the Annual Historical Report; and updated, staffed, and published 12 USABRDL Memorandums. USABRDL's submission record for Officer and Noncommissioned Officer Evaluation Reports was perfect. The Laboratory received a "commendable" rating on its Security Program from the Installation Security Office. The Adjutant's office is the focal point for an athletic program of importance to troop health and morale and for the unit physical fitness program. USABRDL excelled this year at the 1990 Fort Detrick Army Emergency Relief Olympics by winning the Championship Trophy over its nearest competitor, an organization three times its size. Fifty-eight percent of USABRDL's military personnel scored 250 points or higher on the Army Physical Fitness Test, and 24 percent obtained the maximum score of 300.

LOGISTICS BRANCH

The property book value of USABRDL's assets exceeds $7 million, an increase of $.74 million from the previous year. The number of line items within the property book continues to increase. Currently, there are 1,817 line items, an increase of 65 as compared to FY89. Excess equipment turned in to the Property Disposal Office was valued at $828,725. There are 36 hand receipt holders responsible for the control of supplies and equipment--12 in LSD, 11 in HERD, and 13 in FMMDD. During our most recent Command Logistics Inspection, the Property Book Section was commended for having an inventory verification accuracy of 100 percent and providing excellent logistical support to the research mission. The Branch overall was recognized for maintaining excellent files.

Acquisition of expendable supplies and services during FY90 totaled $1,077,986, including $102,609 for contracts to maintain both medical and nonmedical equipment. Additionally, $265,683 was expended through blanket purchase agreements in which small businesses received approximately two-thirds of the transactions. Approximately 6,301 line items were requested for purchase of expendable supplies, durable items, and services (including blanket purchase agreements and self-service items) during FY90. The cost for shipping goods outside the Laboratory doubled this fiscal year for a total of $19,000.

The Laboratory has 31 work orders pending, 7 of which are construction/ renovation projects. During this fiscal year, 17 work orders were initiated, and 8 were completed.

The Physical Security, Crime Prevention, Fire, and Energy Conservation Programs remain sound.

TECHNICAL SERVICES BRANCH

The Technical Services Branch produced 21 test reports involving 2,788 items of medical equipment, pest management equipment and chemical agent antidote delivery systems (autoinjectors). The Branch also upgraded its testing capabilities by designing and building equipment for small item testing in rain and salt spray. The acquisition of an extremely low temperature freezer provides additional capability for low temperature testing. Equipment management continues as a high priority issue in weeding out outdated and outmoded equipment and upgrading as necessary. An analysis of the Branch testing effort indicated that about 59 percent was spent on technical testing, 22 percent was spent on engineering evaluations or technical feasibility testing, 14 percent was spent on first article testing, and 5 percent was spent on materials testing.

INFORMATION MANAGEMENT BRANCH

Automation, telecommunications, technical library, statistics, and visual information support are provided by the Information Management Branch.

Automation and telecommunications support is provided by IMB through two means: a local area network (LAN) of personal computers (PC) and technical services. The PC based LAN architecture provides the maximum in high productivity, end-user computing in an environment which also supports development of corporate information resources. It consists of two types of resources: personal computers and centrally located file server computers to permit sharing of software, data storage, communications, and printing resources. This provides a laboratory-wide computing resource with hardware, software, and data compatibility. The architecture is appropriate for USABRDL's physically dispersed users. Data backup, security, hardware and software installation and maintenance, software development, training, and an extremely high system availability are provided. All network users have access to commercial software as well as applications developed in-house.

The major general use applications are word processing, electronic mail, database management, spreadsheet, and telecommunications. A host of other, more specialized packages is also available.

Technical services include programming and analysis for both business oriented and scientific needs, responding to user trouble calls, maintenance of hardware and software, and user training. Specialized software such as graphics for the Visual Information and Computer Aided Design (CAD) are provided special attention.

Significant software development resources were devoted to both scientific and administrative applications. Efforts in the scientific arena were mostly focused on the aquatic biomonitoring program. The principal administrative system, USABRDL's Management Information System (MIS) supports laboratory-unique information requirements. Personnel, manpower, financial, workload, acquisition, commitment accounting, travel, contract monitoring, and budgeting applications are integrated within the system. Subsystems provide automated support for preparing the civilian performance plan (DA 5397), civilian performance rating (DA 5398), and research and technology work unit summary form (DD 1498). It provides data for Army and USAMRDC standard systems.

Statistical support is provided on an as-required basis to all in-house and extramural research efforts. Support includes experimental design, data analysis, review of contract reports, review of articles, and general statistical consultations as well as statistical method development and manuscript preparation.

VISUAL INFORMATION

The illustration section produces displays, posters, awards, charts, graphs, illustrations, and photographs using both conventional and computer based methods. The addition of both MS-DOS and MacIntosh based computer systems has markedly increased the ability of the illustrators to respond to user needs. Eighty percent of the section's effort is in direct support of projects within USABRDL and Headquarters, USAMRDC, with the remainder going to outside organizations.

TECHNICAL LIBRARY

Library facilities are tailored to USABRDL's special needs. Within resource limitations, it is not possible to provide library assets in-house that cover the full scope of USABRDL's diverse missions. For that reason USABRDL has invested heavily in access to electronic on-line databases for scientific information retrieval. A complete reclassification of the library holdings from the Dewey Decimal System to the National Library of Medicine classification system was completed.

An informational seminar about natural insecticides, in support of a Military Disease Hazards Branch project, was coordinated by the library staff. The seminar was presented by a consultant on poisonous plants and was well received.

THIS PAGE INTENTIONALLY LEFT BLANK.

FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

The Field Medical Materiel Development Division conducts RDTE of medical equipment for the Army (and for the Navy and Air Force as required) and The Surgeon General's RDTE Program on integrated disease vector control systems. The program focuses on medical equipment and materiel for use in far forward and intermediate battlefield locations to support patient care and preventive medicine in the field environment. The FMMDD is committed to developing compact, lightweight, durable and affordable medical equipment to achieve both the Army's demanding service-unique and multi-service mission requirements. Diverse, multidiscipline technologies are integrated to create a wide range of state-of-the-art systems.

The FMMDD is organized according to function into four branches. The Combat Casualty Care Branch (CCCB) integrates the knowledge, skill and experience of health care providers with those of engineering, design and fabrication specialists to create and develop quality field medical materiel for the Army Medical Department and other Department of Defense (DOD) elements. Demonstrating a balance of ruggedness and austerity with modern technology, products researched and developed from CCCB concepts assist the care provider in triage, diagnosis, treatment, and support of combat casualties. The Military Disease Hazards Branch (MDHB) provides preventive medicine units with insecticide application equipment and strategies to effectively suppress vector populations, to protect the soldier with longer lasting arthropod repellents, and to ensure the DOD receives quality pest control equipment. Within DOD, the USABRDL is the only organization devoted to the full scope of formal development and testing of vector control equipment and is the proponent for Federal Supply Class 3740 Specifications. The Industrial Services Branch (ISB) fabricates, modifies and develops initial prototype and test models of field medical materiel. It also produces limited quantities of unique items to support urgent military requirements. The branch exercises good manufacturing practices, provides graphic layouts, evaluates raw materials, assists in prototype testing and can harden and package commercial, non-development items to insure suitability of medical equipment for use by field operating units. It also provides industrial services for medical materiel to other DOD agencies as required. The Systems Development Branch (SDB) tracks technical, financial, and administrative management of specified development and acquisition programs and provides design and drafting services for development of field medical equipment, specifically providing technical data packages, materials, and parts lists.

Fiscal Year 1990 provided tangible evidence of the value of applied research and development in maintaining a high degree of readiness of the Army's combat forces. The immediacy of conflict (Operation Desert Shield) demonstrated the value of FMMDD products. Rapidly deploying field medical units urgently requested Decontaminable Litters, Portable Surgical Scrub Sinks, Far-Forward Surgical Tables, Chemical Protective Patient Wraps, Individual Chemical Resuscitation Devices, and Chemical Protective Blood Box

liners to support their missions. The FMMDD investigators are refining other products that may provide additional support to these units. A portable and rugged drawover vaporizer anesthesia device, an effective cricothyroidotomy device, an affordable demand oxygen controller, and a simple IV pressure infuser are devices that can meet field requirements in their off-the-shelf configuration. Other products such as a battery-powered wound lavage system, a hand-powered IV fluid maker, a battery-powered triage light, and an illuminated hypodermic needle are being developed in-house.

During FY90 FMMDD resources were focused to enhance the technology base. Technological progress translated requirements from field troops and military doctrine into the science and technology essential to meet the user's needs, provided scientific and engineering advice on contractual research and development programs, and helped manage medical equipment systems development and associated test programs. Army readiness issues were handled in a highly productive manner by developing compact, lightweight, durable medical equipment; utilizing exploitable technology; and maintaining a direct linkage with the user community and practicing clinicians. Specifically a total of 51 research and development projects were active during FY90; 9 extramural, 41 in-house, and 1 In-house Laboratory Independent Research (ILIR) were completed. In addition, 18 manuscripts were published in peer-reviewed, national and international journals; 10 presentations of research findings were given at national and international scientific meetings; 2 technical reports, 9 memorandum reports, and 3 extramural study reports/publications associated with FMMDD products were completed; 2 new patent applications have been submitted, and 1 previously submitted patent has been awarded; and numerous briefings were provided to foreign and United States officials.

COMBAT CASUALTY CARE BRANCH

Medical equipment deployable under all battlefield conditions is developed by the Combat Casualty Care Branch (CCCB). This materiel will assist in triage, diagnosis, treatment, and evacuation of combat casualties.

The importance of efforts within CCCB to design, test, and evaluate new field medical materiel were substantiated with the deployment of medical units in support of Operation Desert Shield. New products, such as the Decontaminable Litter, the Far-Forward Surgical Table, and the Portable Surgical Scrub Sink, suddenly were in demand by rapidly deploying medical units seeking lightweight, rugged equipment to support their mission.

Within the context of Desert Shield, the requirements placed on CCCB staff bear witness to the importance of our technology base and professional expertise. The Chemical Protective Patient Wrap was transitioned thru U.S. Army Medical Materiel Agency (USAMMA) to Defense Personnel Support Center (DPSC) for acquisition in 1988; however, it languished in the system until there was an imminent threat of chemical warfare. Procurement officials expedited the paperwork and urgently sought CCCB support to facilitate initial production. Numerous wraps may be procured within the next 2 years.

Other CCCB products have received special consideration because of their application in a chemical warfare environment. A preproduction run of Decontaminable Litters was slated for extensive field testing, prior to the Mideast conflict. Many of these litters are now with units deployed in Saudi Arabia, and CCCB staff are working with procurement specialists to ensure the timely production of more units. In collaboration with CCCB staff, laboratory and clinical evaluations of cricothyroidotomy kits were completed at the Uniformed Services University of the Health Sciences, and at Brooke Army Medical Center (BAMC). The resulting information provided the basis for immediate procurement of kits to support the Resuscitation Device (Individual Chemical). This resuscitation device was designed under contract through CCCB to provide ventilation for the combat casualty in a chemical environment. Finally, to ensure safety from chemical attack of blood supplies, a three-ply protective liner was developed that could be inserted between the cardboard shipping container and the styrofoam liner of the standard blood box. Liners were produced commercially, repackaged with instructions, and shipped to medical units in Saudi Arabia.

As we enter FY91, challenges to support Operation Desert Shield demand our attention. New and existing products that have been deployed must be monitored and evaluated for unexpected problems exacerbated by a hot, dusty environment. Ongoing projects must be completed that will result in useful new devices, such as the Water Recovery and Reuse System for the 2151 field sterilizer and a hand-held IV Fluidmaker for producing infusion grade water economically. Finally, new requirements must be addressed quickly to ensure that medics in the field will have the best resources to deal with the worst casualties in the harshest environment.

Equipment Transitioned to Advanced Development, Procured or Fielded. A Lightweight Medical X-Ray System was designed for far-forward combat casualty care. The developmental project is a collaborative effort between the USABRDL and the University of Wisconsin-Madison (UWM). The USABRDL will be responsible for fabrication of the mechanical components and preparation of production drawings. The UWM will be responsible for fabrication of circuits and overall system assembly and technical testing.

Far-Forward Surgical Tables have been fabricated and delivered to Forward Surgical Teams at Fort Bragg and Fort Campbell. Additional requests have been received. A contract for manufacturing additional tables was awarded.

Portable Surgical Scrub Sinks were fabricated and delivered to the 44th Medical Brigade and airborne medical units. Additional requests have been received. There is a pending contract for several thousand units at approximately $700 per unit, and with a delivery schedule of 1,000 per month.

Special Operations Forces (SOF) Portable Field Sterilizer: A production contract for this USABRDL developed item was awarded 27 September 1990 with a contracting schedule of 29 weeks to completion.

Commercially Available Equipment Evaluated. Market survey results and estimates of design and fabrication costs were presented to Joint Special Operations Command on Modular Container Systems.

A Rugged Litter Sled System was evaluated and data were provided to Headquarters, U.S. Army Special Operations Forces (Airborne) Europe.

Preclinical and Clinical Evaluations Conducted. A Drawover Vaporizer Anesthesia Device was evaluated with laboratory studies at USABRDL and animal studies at Walter Reed Army Institute of Research (WRAIR) and BAMC. Investigators concluded that the Universal PAC Portable Anesthesia System (Ohmeda, Madison, WI) was the safest and most versatile unit. Efforts to obtain a 510K exemption from the Food and Drug Administration for acquisition of a Universal Drawover Vaporizer Anesthesia Device came to fruition late in the year; and medical units may now acquire this device for use in a combat environment.

A nondevelopmental item, Demand Oxygen Controller (DOC) was evaluated with animal studies at WRAIR and clinical studies at BAMC. Data indicate that the Psitron DOC (Columbia, MD) can be used safely with post surgical patients and reduce oxygen consumption by 40 percent on average.

New Equipment Designed. A sturdy, mobile mounting platform was designed and fabricated for a 500 pound, 6.5 kilowatt diesel generator at the request of the Navy Special Warfare Group Two at the Naval Amphibious Base, Little Creek, Norfolk, VA.

A soft-sided, compact dental kit was designed and fabricated for the U.S. Marine Corps. In this kit, combat dentists can carry a complete set of instruments, an electric high speed drill, and medications to perform routine dental care and dental surgery in the field.

A soft-sided case for the Far-Forward Surgical Table was designed and fabricated for a Far Forward Surgical Team who needed a more compact, lightweight container.

Design, fabrication and testing of stabilizing braces for the Field Hospital Bed, and an orthopedic tray for the Portable Surgical Scrub Sink were completed, and Technical Data Packages were prepared and distributed.

INFORMATION PAPERS FOR PROJECTS ACTIVE IN FY90
COMBAT CASUALTY CARE BRANCH

THIS PAGE INTENTIONALLY LEFT BLANK.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0002 28 September 1990

TITLE: Resuscitator/Ventilator, Powered Individual

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F506 CONTRACT: WORK UNIT: 053

RAD: V TYPE OF FUNDING: 6.4 PROJ/TASK: 848CE

REQUIREMENTS DOCUMENT: Draft Joint Services Operational Requirement. 10 July 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reams, William H. COR:

OBJECTIVES: A portable device to provide resuscitation and ventilation to casualties in far forward areas of the battlefield and during evacuation will be identified.

APPROACH: Commercial devices meeting U.S. Army requirements will be identified, procured, evaluated, and modified as needed for fielding.

PROGRESS: Concept Evaluation Program (CEP) test report for the CEP testing conducted in December 1989 was published. The Independent Evaluator's Report is being prepared. Ventilators used in the CEP testing have been checked by the manufacturer and minor modifications are being made as a result of test findings.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0003 28 September 1990

TITLE: Resuscitation Device, Individual, Chemical

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F454 CONTRACT: WORK UNIT: 081

RAD: V TYPE OF FUNDING: 6.3 PROJ/TASK: 993CD

REQUIREMENTS DOCUMENT: Letter of Agreement, 16 January 1984, and Draft Required Operational Capability, 3 August 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reams, William H. COR:

OBJECTIVES: A resuscitation device will be developed that is manually operated, compact, lightweight, and capable of being operated by an individual service member to ventilate conventional and chemical warfare agent casualties in far-forward areas and during evacuation.

APPROACH: A contract will be pursued with industry for fabrication of a device which will be tested and evaluated.

PROGRESS: A Milestone II/III In-Process Review was held August 1990. It was agreed that testing of the developmental Resuscitation Device, Individual, Chemical showed that it met the requirements of the Required Operational Capability and that a final Technical Data Package should be prepared. A commercial hand-operated resuscitator that is chemically hardened has recently become available; and it will be technically tested. Based on the results of this testing, a competitive procurement strategy will be followed.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0004 28 September 1990

TITLE: Development of a Chemically Hardened Noninvasive Battlefield Vital Signs Monitor

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F502 CONTRACT: WORK UNIT: 051

RAD: V TYPE OF FUNDING: 6.4 PROJ/TASK: 848CB

REQUIREMENTS DOCUMENT: Letter of Agreement, 4 January 1983; Draft Joint Services Operational Requirement, 23 January 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reams, William H. COR:

OBJECTIVES: A noninvasive vital signs monitor for use by field medical personnel will be developed. This device will be used to evaluate conventional and chemically contaminated casualties prior to their decontamination at battalion aid stations and rear echelon medical stations.

APPROACH: GMS Engineering has developed a vital signs monitor for measurement of heart rate, respiration rate, blood pressure, and minute volume. Respiration rate and minute volume are detected by a thermistor in a cowling attached to the protective gas mask. Blood pressure and heart rate are detected by a dual bladder cuff that will provide accurate readings in a high vibration environment. Technical testing will be conducted to compare performance of the GMS monitor to that of competitive monitors.

PROGRESS: A Milestone II In-Process Review was held August 1990. Currently there are no commercial or developmental items that meet all the requirements. In all the systems evaluated they either had difficulty or failed to obtain vital signs readings through chemical protective clothing in a high noise/vibration environment. The U.S. Army Medical Materiel Development Activity's position is that the effort should be returned to technical base and a technology watch be maintained.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0005 28 September 1990

TITLE: Technical Feasibility Testing of Delivery Systems for Chemical Warfare Medicaments

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F456 CONTRACT: WORK UNIT: 052

RAD: V TYPE OF FUNDING: 6.3 PROJ/TASK: 993BL

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reams, William H. COR:

OBJECTIVES: Prototype devices designed to deliver chemical warfare agent antidotes will be evaluated.

APPROACH: Technical tests to determine acceptability of commercially available and unique devices for delivery of chemical warfare antidotes will be evaluated.

PROGRESS: Evaluations were performed on a diazepam autoinjector (Duphar, Inc.), and an anti-convulsant autoinjector training device. Both devices passed the specification requirements. Two multi-chamber autoinjectors were evaluated. The Survival Technology, Inc. devices met specifications, but the Duphar, Inc. unit failed to meet the specifications. Test reports on the evaluations were submitted to the U.S. Army Medical Materiel Development Activity.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0007 28 September 1990

TITLE: X-Ray System, Lightweight, Medical

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F530 CONTRACT: DAMD17-88-C-8058 WORK UNIT: 055

RAD: II TYPE OF FUNDING: 6.3 PROJ/TASK: 840HZ
836HE

REQUIREMENTS DOCUMENT: Operational and Organizational Plan, 23 May 86; Draft Joint Services Operational Requirement, 27 Jan 88

LOCATION: U.S. Army Biomedical Research and Development Laboratory and University of Wisconsin-Madison, Madison, WI

PI: Baker, David D., Jr.
Siedband, M. P.

COR: Baker, David D., Jr.

OBJECTIVES: A complete, rugged, lightweight, low-capacity X-ray system for far-forward combat casualty care will be developed.

APPROACH: A design review meeting will be convened to discuss mechanical and performance changes proposed for the current prototypes. The result of this meeting will be a detailed specification for an X-ray device satisfying all the Army Medical Department's low capacity X-ray needs. The developmental effort will be a collaborative effort between the U.S. Army Biomedical Research and Development Laboratory (USABRDL) and the University of Wisconsin-Madison (UWM). The USABRDL will be responsible for fabrication of mechanical components and preparation of production drawings. The UWM will be responsible for fabrication of circuits and overall system assembly and technical testing.

PROGRESS: Design review meetings were held April 1990. Functional requirements and design alternatives of mechanical components were laid out. Designs for the X-ray cassette holder, c-arm assembly, tube head casting, and positioning mast with support platform were initiated. Breadboard circuits with adequate power capacity have been constructed and tested. The addition of several higher power circuit components will add a necessary factor of safety. Major components have been ordered and some received. Fabrication of printed circuit boards and parts for the X-ray cassette holder is near completion. Preparation of engineering drawings of the X-ray cassette holder has begun. A final design review and evaluation was held in September 1990. Design options were finalized and fabrication of all remaining components will begin in October 1990.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0008 28 September 1990

TITLE: Wound Lavage System

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F531 CONTRACT: WORK UNIT: 054

RAD: II TYPE OF FUNDING: 6.3 PROJ/TASK: 840HZ

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Strzelecki, Lorna R. COR:

OBJECTIVES: Develop a small, rugged, lightweight wound lavage system for first echelon and Special Operations Forces use.

APPROACH: Conduct a literature search to determine the efficacy of wound lavage in the treatment of contaminated wounds, optimum irrigation pressures, and wound irrigation equipment and methodologies currently used in emergency departments. Survey the market for wound lavage devices that could be modified to operate in the field using batteries or a nonelectrical energy source. If a unit is not available, a prototype will be developed and tested.

PROGRESS: A less expensive motor was identified, however the seals melted during steam sterilizing testing. A decision was made to use a motor that can be steam sterilized. The prototype utilizing the new batteries, motor, and lightweight plastic housing was completed. The prototype will be subjected to sterilization testing. Arrangements are being made for clinical evaluation.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0011 28 September 1990

TITLE: Technical Feasibility Testing of Medical Materiel (Litter, Folding, Decontaminable)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F567 CONTRACT: WORK UNIT: 008

RAD: II TYPE OF FUNDING: 6.4 PROJ/TASK: 832LE

REQUIREMENTS DOCUMENT: Draft Letter Requirement, January 1983

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reams, William H. COR:

OBJECTIVES: Develop a litter to be used in a chemical environment that is easily decontaminable and provides a surface on which the patient can be easily decontaminated.

APPROACH: Identify materials that can be used for handles, litter cover fabric, and securing strap that is easily decontaminable. Redesign handle to provide a retractable handle that will fit into all evacuation vehicles.

PROGRESS: A Low Production Test (LPT) contract was completed and shipments of litters to test organizations were made. Army, Air Force, and Navy units are participating in the testing. Climatic extremes testing will be conducted in Alaska and Panama. Test organizations have been requested to return User Test Data Sheets to this Laboratory by 30 December 1990.

SEMMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0011 28 September 1990

TITLE: Technical Feasibility Testing of Medical Materiel (Patient Care Utility and Logistical Support Modules for Deployable Medical Systems (DEPMEDS) Hospitals)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F567 CONTRACT: WORK UNIT: 008

RAD: II TYPE OF FUNDING: 6.4 PROJ/TASK: 832LE

REQUIREMENTS DOCUMENT: Letter, DMSB, Code 185, 13 Nov 89, subject: Study of Patient Care Utility Module

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Dubill, Patricia M.
Strzelecki, Lorna R.

COR:

OBJECTIVES: A patient care utility module will be developed to functionally locate utility services, critical devices and materials near the patient's bedside in DEPMEDS-equipped hospitals. A system to support general logistical requirements in patient care areas will be developed.

APPROACH: A market survey will be conducted to identify potentially useful components or systems. Proposed solutions will be presented to the DEPMEDS Coordinating Group (DCG) for review. Technical and user testing will be conducted on the most promising candidates.

PROGRESS: The DCG met to define system requirements and specify the DEPMEDS unit assemblages for application. It was determined that the modules would be used in the Triage EMT/Pre-op, and inpatient care areas. Manufacturers of multipurpose carts, patient service consoles, life support columns/headwall systems, and mobile storage systems were contacted for literature. The literature was analyzed and significant data compiled. A site visit at a DEPMEDS exercise yielded both meaningful data and user comments. Two promising mobile medical equipment modules were obtained on loan, and demonstrated to personnel at the Fort Meade DEPMEDS setup. Their comments and a demonstration of the units were presented to the DCG. THE DCG requested that a less expensive alternative used by the Air Force be obtained for evaluation.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0011 28 September 1990

TITLE: Technical Feasibility Testing of Medical Materiel (Portable Scrub Sink)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F567 CONTRACT: WORK UNIT: 008

RAD: II TYPE OF FUNDING: 6.4 PROJ/TASK: 832LE

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Arnold, Mark F. COR:

OBJECTIVES: Develop a lightweight low-cost portable surgical scrub sink to replace the existing item (NSN 6545-01-117-3894). Areas requiring improvement are weight, volume, cost, durability, and safety. Operation on 110- or 220-volt electricity and use of water from pressurized or nonpressurized sources are required.

APPROACH: A collapsible frame will be designed to support a coated fabric basin. A centrifugal pump will supply water to an in-line thermostatically controlled heater. Water flow will be controlled by using a foot pedal actuated switch and valve assembly. A ground fault interrupter will be provided to protect the user. The electrical system design will minimize leakage currents, providing an additional measure of safety.

PROGRESS: Prototype scrub sinks with half the weight and volume of the existing sink were designed and fabricated. Technical tests and user assessments were completed. Improvements were made for component accessibility, electrical and thermal safety. The draft Military Specifications and Operator's, Organizational, Maintenance Manual was completed. This item was transitioned to U.S. Army Medical Materiel Agency. To meet immediate needs of far-forward medical units, 10 sinks were fabricated and delivered. This is a final Information Summary Paper.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0011 28 September 1990

TITLE: Technical Feasibility Testing of Medical Materiel (Container, Environmental Protection, Medical Supplies)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F567 CONTRACT: WORK UNIT: 008

RAD: II TYPE OF FUNDING: 6.4 PROJ/TASK: 832LE

REQUIREMENTS DOCUMENT: Memorandum, USAMMA, SGMMA-RMP, 25 Jul 90, subject: NSN 6530-01-192-9459 Container, Environmental Protection Medical Supplies, 120 VAC, 50/60/400 Hz or 28 Volts DC.

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Delaplaine, Edward S. COR:

OBJECTIVES: Develop an insulated, heated container to protect medical items subject to damage by freezing in an arctic environment.

APPROACH: Perform a Market Survey to determine the availability of nondevelopmental items. Inspect the three containers from the First Article Test and determine if repairs are feasible. Recommendations will be sent to the U.S. Army Medical Materiel Agency (USAMMA).

PROGRESS: A Market Survey has been completed. The containers have been inspected and potential modifications to the design are being considered.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0012 28 September 1990

TITLE: Steam Vacuum Pulse Sterilizer System (Contract Support)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F570 CONTRACT: DAMD17-87-C-7091 WORK UNIT: 001

RAD: II TYPE OF FUNDING: 6.4 PROJ/TASK: 832JG

REQUIREMENTS DOCUMENT: Letter Requirement, 12 January 1979 (Revised 13 November 1981, 2 July 1985, and 15 June 1988)

LOCATION: MDT Corporation, Rochester, NY

PI: Albright, Donald COR: Arnold, Mark F.

OBJECTIVES: Contracting Officer Representative support will be provided for a U.S. Army Medical Materiel Development Activity contract (87C7091) to develop a sterilizer system which will provide fast, reliable, efficient automatic steam sterilization capability in Table of Organization and Equipment field hospitals.

APPROACH: The sterilizer design uses vacuum-cycle technology to increase air removal speed. Automatic microprocessor-based controls are used to decrease operator work load, increase cycle speed, and ensure that sterilization conditions for the cycle are met. The microprocessor contains built-in test equipment to aid in the diagnosis of electrical and mechanical faults. Backup manual control is provided to permit operation in the event of a control system failure. The sterilization effectiveness of the exposure cycle has been proved by extensive use on commercial products from the MDT Corporation. Water consumption is minimized by using a condensate recovery system in the power module. A standby mode in the steam generator allows the steam pressure to fall to 60 pounds per square inch when the sterilizer module is idle, thereby conserving power.

PROGRESS: Operational Test IIa conducted at Fort Bragg, NC, was completed mid 1Q89. The Operational Test Report has been completed. Deficiencies revealed during testing have been corrected by the vendor and technical and reliability tests performed. Additional operational testing of these re-engineered/modified systems was completed at Fort Sam Houston, TX, February 1990. Testing verified that the system meets or exceeds test criteria under field conditions when operated by user personnel. In-house research and development effort increased power module waste heat rejection by a factor of 10, resulting in more consistent cycle times and greater tolerance to system faults.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0013 28 september 1990

TITLE: Ethylene Oxide Sterilization System (Contract Support)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F571 CONTRACT: DAMD17-87-C-7091 WORK UNIT: 002

RAD: II TYPE OF FUNDING: 6.4 PROJ/TASK: 832JF

REQUIREMENTS DOCUMENT: Letter Requirement, 3 January 1978 (Cancelled by Combat Developer, 14 July 1986)

LOCATION: MDT Corporation, Rochester, NY

PI: Albright, Donald COR: Arnold, Mark F.

OBJECTIVES: Contracting Officer Representative support will be provided for a U.S. Army Medical Materiel Development Activity contract (87C7091) to develop a sterilizer system that will provide fast, reliable, efficient ethylene oxide sterilization.

APPROACH: Design and develop an ethylene oxide sterilizer (EOS) and an aerator to compliment the Steam Vacuum Pulse Sterilization System.

PROGRESS: A contract was awarded to Castle Sybron 2Q87 for the production of six prototype systems. A design change allowed the EOS to become a stand alone unit, no longer dependent on the power module for electrical, vacuum, and steam support. The prototypes and Technical Data Package were delivered in April 1990. The contractor is submitting technical test data to the Food and Drug Administration for system approval.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0017 28 September 1990

TITLE: In-House Research, Combat Casualty Care Materiel (Generator Dolly)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: 742 CONTRACT: WORK UNIT: 232

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874KA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Baker, David D., Jr. COR:

OBJECTIVES: A sturdy, mobile mounting platform will be designed and fabricated for a 500 pound, 6.5 kilowatt diesel generator at the request of the Navy Special Warfare Group Two at the Naval Amphibious Base Little Creek, Norfolk, VA.

APPROACH: A sample generator and basic technical requirements and constraints for the dolly were provided to this laboratory. A mobile mounting platform design will be developed that allows mobility in loose sandy soil as well as stability during operation. The initial conceptual requirements provided to this laboratory were for a two wheeled mounting frame. Due to the extreme weight and operating conditions a large footprint is required. Limited tests will be conducted to determine if two wheels can satisfy the necessary footprint requirements. The final product will likely be a three or four wheeled platform or frame with either locking casters or cam-locked foot pegs.

PROGRESS: A standard heavy-duty fifth wheel cart was purchased. Modification of the rear axle increased the stability and will prevent overturning of the cart when the front axle is turned sharply. A captive wheel chock was fabricated to provide a ground lock mechanism during operation. The handle was modified to allow easy removal and storage during shipping. A commercial battery box was purchased and mounted on the cart along with the generator to protect the battery from the elements. The generator and its fuel bladder were fitted with double-end-shut-off quick disconnect fittings on both the supply and return fuel lines. This provides greater mobility and allows setup and take-down without tools. This project is complete and this is a final Information Summary Paper.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0017 28 September 1990

TITLE: In-House Research, Combat Casualty Care Materiel (Improvements to the USMC Field Dental Kit)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F742 CONTRACT: WORK UNIT: 232

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874KA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Paschal, Charles R., Jr. COR:

OBJECTIVES: The USMC Field Dental Kit will be redesigned to improve bag balance and bag utilization and to include space for the drill set.

APPROACH: A market survey will be performed. The contents of the dental kit will be categorized either by order of use or by type of supply (i.e., drugs, expendables, durables). This information will be used to develop the optimal placement of supplies. A carrying bag for the supplies will be constructed that best accommodates this placement of supplies.

PROGRESS: A market survey was completed, and a commercially available case was purchased to use as a guide for prototype development. The dental set contents were categorized according to purpose (e.g., exploration, extraction, and medication). Roll-up pouches were fabricated to illustrate one method of placing dental instruments inside a case. Herculite™ was chosen as the material for the pouch because of durability and cleaning characteristics. Prototypes were fabricated and sterilization strip tests were performed to insure all areas (outside and inside of the pouch) could be sterilized. Cordura Plus™ nylon fabric was chosen as the material for the carrying case. A prototype case had been fabricated and presented to U.S. Marine Corps (USMC) representatives and to a Tri-Service Dental meeting at the Defense Medical Standardization Board (DMSB). Their suggestions have been incorporated into the second prototype. The second prototype has been fabricated and is awaiting evaluation by the requesting activity.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0017 28 September 1990

TITLE: In-House Research, Combat Casualty Care Materiel (Small Hand-Operated Reverse Osmosis Device (Intravenous Fluid Maker))

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F742 CONTRACT: WORK UNIT: 232

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874KA

REQUIREMENTS DOCUMENT: Memorandum, USAMRDC, SGRD-PLB, 21 Apr 88, subject: IV Fluidmaker

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Burrows, William D. COR:

OBJECTIVES: To develop an intravenous (IV) fluid maker system that is capable of producing water for injection (WFI) from potable water. The entire system will fit into a case the size of a gas mask pack.

APPROACH: The IV fluid maker will incorporate a series of commercially available components or subcomponents that will purify and sterilize potable water. The end product will be tested to ascertain if it meets United States Pharmacopeia (USP) standards. The unit will be designed to be completely manual and can be safely operated in a field environment.

PROGRESS: An IV fluid maker was designed and fabricated using commercially available reverse osmosis filters (Survivor® 06 and Survivor® A90), water purification cartridges, and sterilization filters. Limited testing on the end product indicated that the system is capable of producing WFI that meets USP standards. Ten prototypes (5 survivor® 06 and 5 Survivor® A90) were assembled and thoroughly tested for biological, chemical, and pyrogenic contamination. Preliminary analysis of the results indicate excellent elimination of biological and pyrogenic contaminants, but show chloride levels well above USP standards. However, the chloride levels are believed to be safe for the intended use. At least one of three contract efforts funded through the Small Business Innovative Research Program should produce a more efficient ion exchange unit to enable the system to eliminate enough chloride to meet the USP standards. Contamination testing of all samples was completed. Preparation of the technical report is in progress.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0017 28 September 1990

TITLE: In-House Research, Combat Casualty Care Materiel (Development of a Lightweight Field Table for Fracture Patients)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F742 CONTRACT: WORK UNIT: 232

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874KA

REQUIREMENTS DOCUMENT: Memorandum, DMSB, Code 185, 4 Apr 90, subject: Market Survey Feasibility Analysis of a Field Fracture Table

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reams, William H. COR:

OBJECTIVES: A lightweight table for positioning fracture patients for orthopedic procedures (fracture table) will be developed for use in Army field medical facilities.

APPROACH: A market survey will be conducted to identify foreign and domestic fracture tables that are lightweight, rugged, and can be folded for shipment and storage. If necessary, commercial tables will be modified to meet Army requirements. New development will be undertaken if commercial tables cannot be suitably modified.

PROGRESS: The market survey was completed. Thirty one manufacturers of fracture tables were identified and contacted for information. Most tables were large, heavy and not highly mobile. One manufacturer produced a smaller and lighter weight table that will be obtained and modified for field hospital use. In addition, there is a table used by the military that could also be modified to be lighter and more portable. The market survey and findings were submitted to the Defense Medical Standardization Board.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0017 28 September 1990

TITLE: In-House Research, Combat Casualty Care Materiel (Field Medical Equipment Survey)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F742 CONTRACT: WORK UNIT: 232

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874KA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research and Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Wilson, Marquerite F. COR:

OBJECTIVES: To elicit ideas from National Guard Nurses on improved and additional field medical equipment.

APPROACH: A questionnaire will be designed to survey approximately 1,040 National Guard nurses. Data will be collected on their perceptions of the effectiveness of selected pieces of equipment, and needs for additional equipment. The results will be analyzed and recommendations for improvements, or additions to field medical equipment will be made.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0017 28 September 1990

TITLE: In-House Research, Combat Casualty Care Materiel (Patient Controlled Analgesia (PCA) Devices)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F742 CONTRACT: WORK UNIT: 232

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874KA

REQUIREMENTS DOCUMENT: Letter, DMSB, Code 18J, 6 Apr 90, subject: Market Survey Analysis of Patient Controlled Analgesia Devices

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Dubill, Patricia M. COR:

OBJECTIVES: Commercially available PCA devices will be identified and product data compiled for consideration by the Defense Medical Standardization Board (DMSB).

APPROACH: A market survey and literature search will be conducted using standard references. A database of important characteristics will be developed and a report provided to DMSB.

PROGRESS: The market survey and literature search were completed. Of 27 potential manufacturers contacted for product information, 12 were found to manufacture 18 different PCA models, including several totally disposable devices. Important characteristics related to field hospital use were determined based on published literature and conversations with IV therapists, nurses, and surgeons. An Air Force orthopedist who performed an extensive cost analysis on PCA pumps was contacted for further input. Several product demonstrations were held, and follow-up information was obtained for completion of the database. A final report for DMSB is in preparation.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0017 28 September 1990

TITLE: In-House Research, Combat Casualty Care Materiel (Evaluation of Stethoscopes in High Noise Environment)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F742 CONTRACT: WORK UNIT: 232

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874KA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research and Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Wilson, Marquerite F. COR:

OBJECTIVES: To evaluate acoustic stethoscopes in a high noise environment through chemical protective clothing.

APPROACH: Stethoscopes designed for high noise environments will be evaluated by measuring the ability to hear pulse and blood pressure through chemical protective clothing in a high noise environment.

PROGRESS: A market survey was conducted to identify acoustic stethoscopes designed for use in high noise environments. Seven different stethoscopes are being obtained for the evaluation. Test equipment that reproduces heart sounds has been identified.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0018 28 September 1990

TITLE: Surgical Positioning Device

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F572 CONTRACT: WORK UNIT: 009

RAD: II TYPE OF FUNDING: 6.4 PROJ/TASK: 832LE

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Paschal, Charles R., Jr. COR:

OBJECTIVES: Commercially available lithotomy positioning devices will be evaluated with regard to surgical site exposure and potential patient injury.

APPROACH: Analysis of the electromyographic signals of volunteer subjects will be used as an indicator of postural insult. This data will be used to make a recommendation for the adoption of the best lithotomy positioner.

PROGRESS: Technical information on all commercially available lithotomy positioners was used to divide the devices into categories by anatomical area supported. A literature review revealed a spectrum of complications associated with lithotomy positioning. Complications associated with the positioning device were divided into categories by physiological system affected, and further subdivided into anatomical area affected. This information characterized each of the types of devices. Similar efforts could not be found in the literature. An example of each type of device has been procured, and evaluation will be coordinated with Brooke Army Medical Center Clinicl Investigations.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0019 28 September 1990

TITLE: Clinical Evaluation of Demand Oxygen Controller (DOC)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F573 CONTRACT: WORK UNIT: 010

RAD: II TYPE OF FUNDING: 6.4 PROJ/TASK: 832LE

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Strzelecki, Lorna R. COR:

OBJECTIVES: To verify that the DOC's intermittent flow which utilized 50 percent less oxygen than the continuous mode had no clinically significant change in arterial oxygen concentration.

APPROACH: Since the DOC has been shown to be effective in preclinical trials, the device is to be evaluated clinically on post anesthetic patients using arterial gases as comparative parameters.

PROGRESS: Clinical testing was started at Brooke Army Medical Center in October 1989. Twelve patients undergoing thoracic surgery have now participated in the study. It was decided to analyze the data after 16 patients, and determine if any more patients need to be included in the study. The findings indicate that the DOC's intermittent flow of oxygen when compared to continuous flow oxygen had no clinically significant change in arterial oxygen concentration. Sixteen patients have been included in the studies. Two patients had decreased arterial concentrations while using the DOC. It was believed that a poorly fitting face mask contributed to the decreased concentrations. A final technical report is being prepared.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0020 28 September 1990

TITLE: Upgrade of Field Anesthesia Machine

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F536 CONTRACT: WORK UNIT: 057

RAD: II TYPE OF FUNDING: 6.3 PROJ/TASK: 840HZ

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Dubill, Patricia M. COR:

OBJECTIVES: The design of the field Anesthesia Apparatus, Gas (National Stock Number 6515-01-185-8446) will be upgraded to be more state of the art and logistically supportable.

APPROACH: The field anesthesia machine will be modified to provide: the capability to be operated from high- or low-pressure oxygen or low-pressure air sources; an oxygen flush valve supplied by an independent oxygen source; and a calibrated, thermally compensated, tippable, universal vaporizer. The machine will no longer be equipped to administer nitrous oxide.

PROGRESS: A draft Cooperative Research and Development Agreement (CRDA) was prepared and submitted to the Judge Advocate General's Office (JAG). The JAG reviewer felt that the CRDA would not be approved because it did not fit the concept of the Technology Transfer program. The manufacturer still plans to upgrade the anesthesia machine and will provide a prototype for testing when completed. The project was terminated and the final Information Paper was completed 1Q90.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0021 28 September 1990

TITLE: DEPMEDS Hospital Bed Improvements

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F537 CONTRACT: WORK UNIT: 058

RAD: II TYPE OF FUNDING: 6.3 PROJ/TASK: 840MA

REQUIREMENTS DOCUMENT: Memorandum, USAMRDC, SGRD-PLB, 8 Dec 88, subject: Hospital Bed Improvements, DEPMEDS.

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reams, William H. COR:

OBJECTIVES: A set of stabilizers to improve the lateral and longitudinal stability of the Deployable Medical Systems (DEPMEDS) hospital bed will be developed. Stabilizers must be lightweight, easily and quickly installed without tools, and shippable and storable with the other bed accessories. A method for attaching traction devices will be assessed.

APPROACH: Baseline stability will be determined through stress analyses and deflection tests of the bed in response to side and end forces. Stabilizers will be designed, fabricated, and tested. The design will be optimized for field use by considering size, weight, ruggedness, and ease of use. A Technical Data Package will be prepared, and stabilizers will be field tested. Design a method to apply traction device to the bed.

PROGRESS: The design of the stabilizers was optimized for quick and easy attachment without tools and to fold for easy storage with the other bed accessories. A Technical Data Package was completed. A technical report was published and distributed. The traction device for use on the DEPMEDS bed was identified and ordered.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0022 28 September 1990

TITLE: Special Operations Wheeled Field Litter

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F733 CONTRACT: WORK UNIT: 221

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874MA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reams, William H. COR:

OBJECTIVES: The objective is to provide Special Operations Forces (SOF) with a small number of specialized accessories for the Wheeled Litter Carrier.

APPROACH: Detailed requirements for the accessories will be determined through discussions with the Joint Special Operations Command (JSOC) representatives.

PROGRESS: Puncture-resistant tires, round litter clamp knobs, and hammock-type storage pouches made of polypropylene mesh have been provided to SOF. Forward airway management tray and an over bed work surface design are awaiting fabrication. Two similar hammock-type storage pouches were fabricated and sent to 10th Medical Battalion in January 1990.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0023 28 September 1990

TITLE: Field Infusion Fluid Warmer

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F734 CONTRACT: WORK UNIT: 231

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874HZ

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Paschal, Charles R., Jr. COR:

OBJECTIVES: A portable, self-contained infusion fluid warmer will be developed primarily for use in Battalion Aid Stations and in transport vehicles.

APPROACH: A market survey of commercial infusion fluid warming devices will be conducted. Acceptable products must have an integral power source and must prevent freezing or substantial cooling during patient transport and/or temporary storage. Fluid temperatures (70-97°F) must be maintained for up to 12 hours without requiring recharge or replacement of the power source. If no commercial products satisfy these additional requirements, an infusion fluid warmer will be designed, fabricated, and tested.

PROGRESS: A market survey for infusion fluid warmers identified no commercial products meeting essentially all necessary characteristics. A battery powered commercial unit obtained for testing failed to maintain IV fluid temperatures for acceptable time periods. An insulated pouch (Bag, Heated, IV (BHIV)) was designed and tested with a reusable chemical heat source. A mathematical model was developed to simulate heat transfer characteristics of the BHIV. The information obtained from the model provides minimum insulating and heat source requirements. The manufacturer of the commercial infusion fluid warmer submitted an improved version of their product for testing. The new version maintains acceptable fluid temperatures for more than seven hours. Although the performance of this product is acceptable, the size, weight with battery, and capacity limit of one 500 ml IV bag is much less than ideal. A BHIV with a capacity of two 1000 ml IV bags and a lighter power pack will be fabricated and tested in-house.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0024 28 September 1990

TITLE: Ortho Tray for Surgical Scrub Sink

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F735 CONTRACT: WORK UNIT: 233

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874MA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Paschal, Charles R., Jr. COR:

OBJECTIVES: A prototype tray will be developed to insert in the newly designed scrub sink for use during wound debridement of orthopaedic injuries.

APPROACH: A prototype tray will be designed, fabricated, and tested. From the test results, the preliminary design will be modified to produce a completed Technical Data Package.

PROGRESS: A preliminary prototype was fabricated. Design was accepted by an orthopaedic surgeon. User evaluation by an orthopedist with the Far-Forward Surgical team in Saudia Arabia is to begin in 1st Qtr, FY 91

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0025 28 September 1990

TITLE: Development of a Far-Forward Surgical Table and Accompanying Accessories

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F736 CONTRACT: WORK UNIT: 234

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874MA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Paschal, Charles R., Jr. COR:

OBJECTIVES: A lightweight, easily disassembled, and easily packaged surgical table for far-forward use will be designed and fabricated. Surgical lighting, intravenous poles, an armboard, and an instrument tray will be included.

APPROACH: A prototype table will be designed and fabricated. This table and its accessories will be used in field tests. Based on the test results, the table and each of its accessories will be modified, and each change will be evaluated separately. Ten tables will be built in-house in response to a stated need. These modifications will be incorporated into a complete Technical Data Package for transition to the U.S. Army Medical Materiel Agency (USAMMA) for acquisition. This Laboratory will coordinate the production of 50 additional tables at the request of the Office of the Surgeon General.

PROGRESS: A market survey identified a United States source for surgical lights to replace British lights. A packing container was designed and fabricated for the table and its accessories. In-house fabrication of the ten tables to meet the stated need was completed. The technical drawing package and parts list were completed. Efforts to contract for fabrication of 50 tables is anticipated 1Qtr, FY91.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0028 28 September 1990

TITLE: Illuminated Hypodermic Needle

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F739 CONTRACT: WORK UNIT: 237

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874MA

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Dubill, Patricia M. COR:

OBJECTIVES: A hypodermic needle adapted to emit light from its distal end will be developed to facilitate venapuncture under poor lighting conditions.

APPROACH: An optical fiber will transmit light from a small light source to the distal end of a needle in an intravenous catheter placement unit. Venapuncture will be guided by the fiber optic illumination visible through the translucent skin and vein. The prototype will be evaluated using a simulated superficial vein, and follow-on preclinical and clinical studies will be conducted to facilitate finalization of the design.

PROGRESS: Miniature visible and infrared reusable light sources were obtained and a bench model of a superficial vein was developed. Prototype illuminated needles were assembled and tested in vivo, with satisfactory results. Infrared light sources were tested in conjunction with night vision goggles. Chemiluminescence-based light sources were investigated to study the feasibility of developing a totally disposable unit. Insufficient light was produced by these sources (both visible and infrared lightsticks) to facilitate venapuncture in the dark. Arrangements for cadaver studies were made with a collaborating U.S. Army Reservist. An abstract was accepted by the 12th Annual International Conference of the Institute of Electrical and Electronics Engineers Engineering in Medicine and Biology Society.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0029 28 September 1990

TITLE: Lightweight X-ray Film Development Kit

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F740 CONTRACT: WORK UNIT: 238

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874MA

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Baker, David D., Jr. COR:

OBJECTIVES: A complete, lightweight, self-contained, X-ray film developing kit will be developed for support of far-forward X-ray capability.

APPROACH: A market survey will be conducted to identify commercially available manual X-ray film processing systems. Systems meeting the requirements should contain stainless steel tanks (Alloy No. 316) and be configured such that developing and fixing solutions can be heated from multiple energy sources. If no suitable commercially available products are identified, two prototypes will be fabricated in-house. One kit will be provided to the 10th Medical Battalion, 10th Mountain Division (Light Infantry) for user testing, and one will be retained for in-house environmental testing.

PROGRESS: A market survey identified no commercially available manual developing systems that adequately meet the need. Commercially available table-top automatic and manual film processing systems are more exotic and sophisticated than desired. The initial approach for a developmental kit included nesting manual dip tanks. This approach proved not feasible because of overall weight and necessary fixing and developing solution volume. The most practical solution proved to be standard photography processing trays. This allows variable fixing and developing solution volumes, minimum weight, and the complete kit will be composed of off-the-shelf items. Changes in brand name or mixture quantity of developing and fixing solutions will have little impact on the use of the kit. Before assembly of the prototype kits, a final design alternative will be explored. Dip tanks will be designed and constructed using a fiber reinforced rubber. The tanks will be collapsible for storage and will mount in a folding frame when in use.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0030 28 September 1990

TITLE: Field Triage Light

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F741 CONTRACT: WORK UNIT: 239

RAD: II TYPE OF FUNDING: 6.2 PROJ/TASK: 874MA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Baker, David D., Jr. COR:

OBJECTIVES: Develop a man-portable, battery powered, medical quality field examination light for use in triage of casualties on the ground outside of field medical facilities during mass casualty situations. Light should have a secondary use as an emergency surgical light at far-forward medical facilities.

APPROACH: Develop a battery case that holds rechargeable batteries of sufficient capacity to provide up to eight hours of power. The case will also serve as a weighted base for the lamp and will have integral controls and recharging circuitry. This will be married with a suitable lamp, carried on a flexible arm having sufficient reach to be used over a litter, either on the ground or on a litter stand.

PROGRESS: The initial prototype design used a 30 watt sealed beam lamp mounted on a flexible pipe attached to a battery box. A new design is being explored that uses an 18 watt, 24VDC fluorescent u-shaped tube that provides the equivalent light of a 90 watt incandescent light bulb. This lamp requires a little more than half that power of the initial design. A prototype 18 watt, 24VDC fluorescent lamp was provided on loan by the manufacturer. Preliminary tests on this lamp showed the light to be much more diffuse than the sealed beam lamp. Since there are situations that may require the concentrated light, the prototype will be designed with interchangeable 24VDC fluorescent and incandescent lamps. The unused lamp will be stored in the battery box.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCI-0031 28 September 1990

TITLE: Flywheel Powered X-ray System Generator

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: 304 CONTRACT: WORK UNIT: 006

RAD: II TYPE OF FUNDING: 6.3 PROJ/TASK: 836HA

REQUIREMENTS DOCUMENT: U.S. Army, Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Baker, David D., Jr. COR:
Arnold, Mark F.

OBJECTIVES: A complete self-contained flywheel powered generator with sufficient power to support a high capacity X-ray machine will be developed. A complete Technical Data Package will be produced in conjunction with development.

APPROACH: A detailed analysis and performance study of the prototype flywheel powered X-ray machine produced by the University of Wisconsin-Madison will be conducted. Professor Melvin Siedband will be used as a consultant. The power requirements and configuration of the high capacity X-ray machine will be studied to develop operating requirements of the flywheel generator. Market surveys of AC powered induction motors and high performance alternators will be conducted to determine the optimal motor/generator to power the flywheel and generate power. Separate motor and generator components and harsh environment industrial process controllers will be explored for use in this second generation development. A complete Technical Data Package will be produced in conjunction with the developmental effort.

PROGRESS: A Joint Working Group (JWG) was convened 6 February 1990 to identify the need and requirements of the flywheel generator. The Combat Developer maintained there was no need for this product since it would not result in the elimination of one of the large generators already used in Deployable Medical Systems Hospitals. The concensus of those present was to suspend effort on this project until the Combat Developer identifies a need. This is a final summary information paper.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCE-5002 28 September 1990

TITLE: Self-Development X-Ray Film

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-87-C-7221 WORK UNIT: 169

RAD: II TYPE OF FUNDING: 6.5 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Department of Defense FY - 1990 Small Business Innovation Research (SBIR) Program

LOCATION: Energy Optics Incorporated, Las Cruces, NM

PI: Robillard, J. J. COR: Baker, David D., Jr.

OBJECTIVES: A non-silver dry process X-ray film material will be developed that requires only daylight heat developing.

APPROACH: A Phase II effort will be conducted to optimize processes developed during Phase I. An improved thermal processor for the new material and specifications to be used for future production will be developed. In order to optimize the sensitive emulsion, relationships between sensitivity, grain size, grain density, and nature of the binder will be studied. The emulsion will also be extended for use on transparent films by introducing heavy metals that are either soluble in the binder or are transparent compounds miscible with the binder. A microwave thermal processor will be developed to accurately deliver the optimal amount of heat to the film.

PROGRESS: The interim report for the first six months of research was reviewed and found acceptable after revisions. The second part of the Phase II effort was initiated at the beginning of 2Q90. Optimization of film based emulsions has progressed with good results. Emulsions containing Barium-Copper complexes have produced transparent films of acceptable color. Construction of the prototype microwave processor has begun. An important parameter for the film processor is development speed, or speed that the film is moved through the unit. The speed of development was found to affect contrast, resolution, and density. Fast development speeds result in good contrast and resolution, but low density, while slower development speeds give better density but low contrast and resolution. Extensive testing found the optimal development speed of 20 centimeters per second. Once the microwave processor is complete, final refinements to the film emulsion will be possible. For the final months of this contract effort, a hand-held dental X-ray machine was provided on loan to the contractor. This will allow many rapid iterations of the emulsion to optimize the film and processor characteristics.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCE-5004 28 September 1990

TITLE: A Portable Multi-Mode X-Ray Imaging System

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-88-C-8203 WORK UNIT: 171

RAD: II TYPE OF FUNDING: 6.5 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Department of Defense FY - 1990 Small Business Innovation Research (SBIR) Program

LOCATION: Rayex Corporation, Rockville, MD

PI: Motz, J. W. COR: Baker, David D., Jr.

OBJECTIVES: The feasibility of using the Rayex patented one-sided computed tomography (CT) system in place of conventional CT systems will be determined. The system would have the capability of operating in four diagnostic modes, including CT, partial CT, conventional radiography and fluoroscopy.

APPROACH: A slot camera, solid state X-ray detector panel, mechanical scan system, and computer processing system will be designed and fabricated to produce a prototype one-sided CT. Performance will be tested for comparison to predictions from the Phase I effort.

PROGRESS: Design and construction of the X-ray detection panel was initiated. Tests of scintillation detectors of different sizes have shown that detectors 2 mm wide x 10 mm deep x 150 mm long are optimal for the panel. The complete X-ray detector panel will consist of 100 scintillation detectors aligned side by side with a photomultiplier tube (PMT) connected to each. The close proximity of individual scintillation defectors makes attaching the PMTs difficult, but two methods are being tested. First, simply staggering the PMTs along the length of the scintillation detectors proved inefficient. The second, and more complex method involves using light guides to channel the emitted light to a more remote PMT. Preliminary testing of this second method has begun. Design of the slot camera was also initiated, but fabrication must wait until the final design for the detector array is complete since some parameters depend on its dimensions.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCE-5007 28 September 1990

TITLE: Development of a Multifrequency Jet Ventilator for Use Under Battlefield Conditions

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-87-C-7053 WORK UNIT: 174

RAD: II TYPE OF FUNDING: 6.5 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Department of Defense FY - 1990 Small Business Innovation Research (SBIR) Program

LOCATION: Scientific Research Associates, Glastonbury, CT

PI: Weinberg, Bernard C. COR: Dubill, Patricia M.

OBJECTIVES: A portable, lightweight, ultrahigh frequency jet ventilator for ventilating battlefield casualties will be developed and evaluated.

APPROACH: Phase I compared conventional positive pressure ventilation, high frequency jet ventilation, and ultrahigh frequency jet ventilation in laboratory animals with penetrating chest injuries. Phase II will determine the efficacy of ultrahigh frequency jet ventilation for animals with penetrating chest wounds, hypovolemia, and Adult Respiratory Distress Syndrome, using room air or medical grade oxygen. Human trials will be conducted in patients with chest trauma. Three ultrahigh frequency jet ventilators will be delivered to the USABRDL.

PROGRESS: The advanced concept model was received and several design changes were recommended. The fourth series of experiments was completed, data were analyzed, and results are forthcoming. Revisions in the animal protocol were made, as well as a no cost contract extension to 30 Jun 91. Surgery on several animals in the final series of experiments (simulating penetrating chest injury patients ventilated with room air) has been successfully completed. Food and Drug Administration approval for the clinical trauma study was obtained, and Institutional Review Board approval of the protocol is pending. Three additional trauma centers have agreed to participate in the study.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCE-5008 28 September 1990

TITLE: Surgical Instrument Decontamination Unit

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-88-C-8188 WORK UNIT: 163

RAD: II TYPE OF FUNDING: 6.5 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Department of Defense FY - 1990 Small Business Innovation Research (SBIR) Program

LOCATION: Abel Company, Pembroke, VA

PI: Abel, Kenneth COR: Strzelecki, Lorna R.

OBJECTIVES: To develop a surgical instrument decontamination unit that is lightweight, small, and water and manpower efficient. To determine if a modified two-compartment ultrasonic vapor degreaser or hydrogen peroxide solution can be both an effective cleaner and sterilant for surgical instruments. Ultrasonic cleaning units have been employed in the past to wash the instruments after the decontamination process. Hydrogen peroxide, in combination with heat and ultrasonics, however, has not been previously explored.

APPROACH: The researcher proposes a modified two-compartment ultrasonic unit that utilizes the synergestic effect between hydrogen peroxide and sonication to decontaminate and sterilize surgical instruments. A prototype will be constructed and used in the initial phase of research to test the cleaning capabilities of the proposed system. A proteolytic enzyme/detergent cleaner will be used in the ultrasonic compartment.

PROGRESS: The SBIR contract was completed and final report was received. Results showed that the synergistic effect between hydrogen peroxide and sonication is effective in achieving total sterilization when preceded by a precleaning treatment in a proteolytic enzyme/detergent cleaner. This two-step procedure is faster for cleaning and sterilizing instruments than any other method presently in use. Phase II effort was funded March 1990. Fabrication of the initial testing prototype has been completed and non-biological testing has begun. Tests to determine the effect of increased hydrogen peroxide concentration at constant time and temperature will continue using the breadboard system.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCE-5009 28 September 1990

TITLE: Development of Design Parameters and Conceptual Drawing for a Plasma Etcher to Clean and Sterilize Surgical Instruments

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-88-C-8190 WORK UNIT: 165

RAD: II TYPE OF FUNDING: 6.5 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Department of Defense FY - 1990 Small Business Innovation Research (SBIR) Program

LOCATION: Anatech, Ltd., Alexandria, VA

PI: Barr, Robert W. COR: Strzelecki, Lorna R.

OBJECTIVES: To develop a surgical instrument decontamination unit that is lightweight, small, water, and manpower efficient. To identify the optimum conditions under which plasma etching methods can be employed to remove blood, tissue, and microorganisms from stainless steel surgical instruments. To establish design parameters for a suitable instrument.

APPROACH: Tests of etching efficiency will be carried out with stainless steel instruments to which blood, tissue protein or bacteria have been applied. Test materials will be etched under various experimental conditions using plasma etching instruments. After etching, test materials will be evaluated to determine whether organic materials have been completely removed. Evaluation will include visual examination and microbiological analyses.

PROGRESS: The final report has been received. Plasma etching used accelerated ions to remove organic matter by physically desorbing molecular fragments and reacted chemically to produce volatile nontoxic gases such as CO_2. Work performed included determination of optimal size of the chamber; arrangement of instruments in the chamber; required power density; evaluation of alternative power sources; and generation of design parameters and conceptual drawing of the device. Phase II effort was funded in March 1990. Work has proceeded in two areas: construction of a proof-of-principle experiment for a large area discharge, and modification of the process chamber design. The electronics of the Anatech Enhanced Power Supply (EPS) is being modified to fit the power supply design for the sterilizer.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCE-5010 28 September 1990

TITLE: Development of an Advanced Life Detector

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-88-C-8143 WORK UNIT: 263

RAD: V TYPE OF FUNDING: 6.2 PROJ/TASK: 875AF

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: GMS Engineering Corporation, Columbia, MD

PI: Samaras, George M. COR: Lorna R. Strzelecki

OBJECTIVES: A Flash Reflectance Oximeter that can provide an instantaneous reading through protective clothing will be developed. The proposed device will be battery powered and will be about the size and weight of a standard flashlight. It can be employed either as a triage instrument, providing a rapid assessment of the general status of a living casualty, or as a dead/alive determiner, given a threshold value of oxygen saturation below which recovery is not possible.

APPROACH: The device will employ a very high intensity flash of light from light-emitting diodes operating at two specific wavelengths and measure the amplitudes of the reflected returns. One wavelength return represents the absorption of light by oxygenated hemoglobin and the other that of deoxygenated hemoglobin. Blood oxygen saturation is then a function of the ratio of intensities of the two returned wavelengths and is calculated by a microprocessor in the device and displayed to the operator.

PROGRESS: Six demonstration prototypes have been delivered and are being evaluated. Preliminary results indicate that while the concept has been successfully demonstrated, some additional development effort is required to obtain the desired performance when reading through clothing; particularly Mission Oriented Protective Posture fabric. The present deficiency is thought to be a simple case of inadequate source intensity. A safety assessment has shown that LASER diodes can safely be substituted for the current light remitting diodes. This contract effort is complete, however, a follow-on contract effort is being considered. The U.S. Army Medical Materiel Development Activity will assume responsibility for any further developmental efforts. This is a final Summary Information Paper.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

COMBAT CASUALTY CARE BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: CCCE-5012 28 September 1990

TITLE: Continuous High Power X-ray Tube

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-89-C-9139 WORK UNIT: 167

RAD: II TYPE OF FUNDING: 6.5 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Department of Defense FY - 1990 Small Business Innovation Research (SBIR) Program

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Peschmann, K. R., Jr. COR: Baker, David D., Jr.

OBJECTIVES: The feasibility and operating characteristics of a novel, high-voltage, high duty cycle X-ray tube design will be determined.

APPROACH: In order to determine the feasibility and operating characteristics of the proposed tube, a mechanical and electrical layout will be completed. The anode will be part of a hermetically sealed vacuum envelope. Two stationary coil magnets will surround the vacuum envelope. One magnet will be a deflection coil, producing a constant magnetic field; and the other will be a quadrapole coil for focusing the electron beam on the anode surface. The entire vacuum envelope will rotate on bearings mounted in a frame outside the high-temperature area. In conventional X-ray tube designs, bearings, which are mounted inside the high-temperature vacuum area, are usually the first component to fail. Feasibility of the proposed design will largely depend on the ability to produce and maintain the necessary small focal spot for medical imaging.

PROGRESS: The design and engineering drawings of the proposed x-ray tube are complete. The completed design eliminates the three major problems of conventional medical X-ray tubes. First, the bearings are removed from the high temperature area. Second, the anode is not suspended in vacuum, but fully accessible for direct cooling. Third, the anode is not cantilevered in the tube envelope, but is an integral part of the vacuum envelope. The result is a rugged, high duty cycle x-ray tube. The final report submitted under this Phase I effort documents the design, contains engineering drawings, calculations for electron beam optics, magnetic coil parameters, and projected performance. The maximum average power input to the anode is calculated to be 12.6 kilowatts with a 0.5 mm x 1.4 mm focal spot. The Phase II proposal was received and reviewed. A Phase II effort will not be funded. This is the final Information Summary Paper for this work unit.

MILITARY DISEASE HAZARDS BRANCH

The Surgeon General's RDTE program for disease vector control methods, materials, equipment and long-lasting repellents is supported by the Military Disease Hazards Branch. Within the DOD, USABRDL is the only organization devoted to the full scope of formal RDTE of long-lasting, broad spectrum repellents and vector control equipment. Necessary to this effort is evaluation of materials for use in equipment and development of optimum utilization methods for equipment and materials. Off-the-shelf items of vector control equipment developed for civilian use are not sufficiently small and lightweight. USABRDL evaluates civilian equipment and where feasible proposes design changes to the equipment to make it suitable for military use. When needs cannot be met by product modification, development is undertaken making maximum use of easily procurable parts.

Emerging Technology. Several USABRDL vector control projects represent attempts to capture emerging technology. A new generation of unmanned aerial vehicles is being developed elsewhere for military use. A prototype ultra-low volume pesticide dispersal payload module is being designed by USABRDL as a conceptual model. The pesticide dispersal module may increase arthropod control by 75 percent through ability to spray vectors when they are most active (dawn, night, and dusk) and ability to conduct far forward spray missions currently prohibited.

The natural plant products studies indicated that plant extracts definitely can contribute to vector suppression. Catharanthus and Bougainvillea are of special interest since the alkaloids and extracts prevent egg production in the female when the female is treated and also when pupae received the treatment. Due to their larval toxicity and sterility effect in adults, these compounds seem promising for future mosquito control operations.

A Cooperative Research and Development Agreement was formed between USABRDL and the 3M Company for developing broad spectrum composite repellents to provide protection from disease vectors and pests, especially biting midges, biting flies and malaria vectors. Concept validation and preliminary studies are being conducted now.

Focus on a Current Vector-Borne Disease Problem. A cooperative Army-Navy field study for long term control of the tick, Ixodes dammini (Lyme disease vector) indicated that liquid cyfluthrin gave 99 percent control while granular cyfluthrin gave 89 percent control over a 78-day period.

Equipment Transitioned to Advanced Development, Procured, or Fielded. The Helicopter Slung, Multicapability, Pesticide Dispersal Unit successfully passed First Article Testing after minor modifications. This USABRDL-developed unit disperses solid or liquid insecticides for vector control and operates under any rotary-winged aircraft equipped with a cargo hook. It is electrically independent of the aircraft and is hooked up or released in seconds.

Technical testing of the Aerosol Generator, Ultra-Low Volume, Electric-Powered was completed. A new model rotary atomizer is being evaluated for possible incorporation into the current prototype. Engineering development prototypes are being fabricated for Technical Test II and user testing by the Academy of Health Sciences, U.S. Army. This equipment represents a six-fold reduction in weight and a four-fold reduction in volume over the item it replaces and eliminates a need for gasoline fuel.

Engineering evaluations of the PD-5 compression duster and the B&G pressure duster were completed. The tests showed both units leaked under pressure. A recommendation was made to the Armed Forces Pest Management Board that these units have very limited military use.

New Equipment Designed. A lightweight hydraulic sprayer for larval mosquito control by preventive medicine units was designed, and a prototype was fabricated. This equipment is powered by the electrical system of the transporting vehicle and reduces weight by 80 percent and volume by 50 percent over the replaced item.

A pocket portable solid state Army miniature light trap to be carried in a pocket of the Battle Dress Uniform was fabricated. Field comparison tests between this trap and the standard solid-state Army miniature light trap are scheduled for next year.

Other Successes. A Material Transfer Agreement was coordinated and executed with W.H. Cottrell, Jr., M.D., Inc. to evaluate current troop issue controlled-release repellent on their Amazonian Expedition to Manaus, Sab Gabriel de Cachoeira and Pico de la Neblina National Park in Brazil against mosquitoes, sandflies, and black flies.

The inclined sliding gate membrane metering system was developed for the Model DM-9 backpack sprayer to distribute metered amounts of solid-formulation pediculicide to 17 sites per person. This system had negligible leakage and was the most accurate of the five meter designs developed and evaluated.

A field study in the Dominican Republic indicated that aerosol droplets with a Vmd range of 13-46 microns were reaching interior rooms when aerosols were not obstructed by vegetation or structural barriers although in concentrations unlikely to be effective in control of Aedes aegypti, the primary vector of dengue fever.

A field study has been initiated with Sarasota County, FL, Mosquito Control District to evaluate effectiveness of insecticide aerosols on sentinel mosquitoes and to provide indices of the effect on natural mosquito populations. Enzytec^{R} tickets and droplet slide spinners will be used for collecting aerosol droplets.

INFORMATION PAPERS FOR PROJECTS ACTIVE IN FY90
MILITARY DISEASE HAZARDS BRANCH

THIS PAGE INTENTIONALLY LEFT BLANK.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0001 28 September 1990

TITLE: Vector Control Science Base

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F252 CONTRACT: WORK UNIT: 001

RAD: I TYPE OF FUNDING: 6.1 PROJ/TASK: S13AS

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Solberg, Victoria B. COR:

OBJECTIVES: To develop and maintain a Vector Control Science Base that will ensure the applied research program is current in new developments and to develop new, militarily unique approaches to an integrated program.

APPROACH: Through the use of in-house expertise and extensive interrelationships with other government agencies and the private sector, conduct basic research centering on militarily unique aspects of a vector control program.

PROGRESS: A manuscript on monitoring of aerially applied pesticide penetration of dwellings in the Dominican Republic is in preparation. Evaluation of polypropylene as a collection substrate for rapid, reliable monitoring of pesticide application effectiveness has been completed. A field study has been initiated with Sarasota County Mosquito Control District, Sarasota, FL to test this method under operational conditions. This field study encompasses several methods of monitoring the aerosol cloud and its effectiveness to include Enzytec tickets, sentinel mosquitoes, and droplet slide spinners.

4TH QUARTERLY SUMMARY INFORMATION PAPER, FY89

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0002 29 September 1989

TITLE: Toxin Decontamination Unit

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F440 CONTRACT: WORK UNIT: 033

RAD: I TYPE OF FUNDING: 6.1 PROJ/TASK: S12AA

REQUIREMENTS DOCUMENT: Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Bunner, Bobbie L. COR:

OBJECTIVES: To modify existing pesticide dispersal equipment for dual capability as personnel decontamination unit. To evaluate efficacy with *in vivo* animal testing using T-2 Mycotoxin.

APPROACH: Type classified pesticide dispersal equipment will be modified to obtain optimal efficiency in removing contaminants from skin using a soap-and-water spray. The efficacy will be tested using simulants and biologic toxins on rat models.

PROGRESS: All projected animal studies have been completed. Data have been published in a peer reviewed journal. A final report has been completed and forwarded to the U.S. Army Medical Research Institute of Infectious Diseases. Results were presented at the U.S. Army Medical Research and Development Command 1989 Medical Defense Bioscience Review and published in the proceedings. Recommendations on the use of preventive medicine spray equipment for field expedient dermal decontamination of chemical/toxin contaminated personnel have been forwarded to the Combat Developers, U.S. Army Chemical School, and the Academy of Health Sciences for incorporation in their respective field and training manuals. Project has been completed.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0003 28 September 1990

TITLE: Control of Biological Warfare Threat Vectors

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F441 CONTRACT: WORK UNIT: 035

RAD: I TYPE OF FUNDING: 6.1 PROJ/TASK: S12AA

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Perich, Michael J. COR:

OBJECTIVES: Develop methods to control vectors of potential biological warfare agents. Provide baseline laboratory and field data on the efficacy of various pesticides and application equipment for the control of the vectors. Develop field methodology for use by Army Preventive Medicine Units.

APPROACH: Develop insecticide application techniques which capitalize on biological differences of vectors of diseases used in military operations and that are not naturally occurring epidemic diseases.

PROGRESS: A comprehensive literature review on the bionomics and control of Venezuelan equine encephalitis (VEE) vectors indigenous to Brazil was completed. Integrated vector control strategies will be selected, modified or developed for testing in the United States and then transitioned to the indigenous areas. Small field plot evaluation of pelletized methoprene against flood water and salt-marsh mosquitoes, in South Carolina, will be completed in October 1990.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0004 28 September 1990

TITLE: Pesticide Dispersal Unit, Multicapability, Helicopter Slung

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F575 CONTRACT: WORK UNIT: 043

RAD: I TYPE OF FUNDING: 6.4 PROJ/TASK: 832CH

REQUIREMENTS DOCUMENT: Required Operational Capability, 30 Jan 87

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Anderson, Leroy M. COR: Anderson, Leroy M.

OBJECTIVES: To identify a suitable commercial helicopter slung pesticide dispersal unit (PDU) which has the capability to disperse both solid and liquid pesticide formulations. The unit is operated by one person, self-powered, electrically independent of the aircraft and will be used for application of pesticides for disease vector control.

APPROACH: A commercially manufactured sprayer was selected as the most suitable unit for field feasibility testing. Modifications were made, and the unit was successfully tested in actual mosquito control operations.

PROGRESS: The three First Article Test Units received final acceptance after incorporating some minor modifications. Two of these have been shipped, and the third is scheduled for shipment to the Air Force. A Provisioning Conference was held at the contractor's facility on 17-19 Apr 90. Nine of the PDUs satisfactorily passed a quality assurance inspection during a site visit on 26-28 Jun 90. The remainder of the PDUs are scheduled for inspection during 1Q FY91. A technical review of the draft operator's manual was completed and comments were provided to the U.S. Army Troop Support Command. This review resulted in the rewriting of a chapter concerning operator's procedures during the Manual Validation Conference, 10-14 Sep 90.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0005 28 September 1990

TITLE: Configuration Management (FSC 3740) Equipment

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F563 CONTRACT: WORK UNIT: 003

RAD: I TYPE OF FUNDING: 6.4 PROJ/TASK: 832CJ

REQUIREMENTS DOCUMENT: Standardization Directory (SD-1)

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Anderson, Leroy M. COR:

OBJECTIVES: Prepare and revise military specifications for pest control equipment - Federal Stock Class 3740. Incorporate new technological advances into specifications to ensure procurement of militarily acceptable equipment.

APPROACH: Military specifications which are used by procurement agencies are prepared to outline performance standards and ensure that pest control equipment meets minimum acceptable performance criteria. Detailed drawing packages are developed as part of the military specification for some equipment.

PROGRESS: Revision of military specification, MIL-S-14102, Sprayer, Insecticide, Manually-Carried, Hand-Operated-Compression, was completed. It is scheduled for review by the Review and User Activities.

The Commercial Item Description (CID), A-A-52286, Sprayer, Pesticide, Pushcart Mounted has been submitted for publication.

The specification, MIL-T-52062, Trap Mosquito Light, is being changed to a CID which includes the New Jersey and Army Collapsible style insect surveillance traps.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0006 28 September 1990

TITLE: Vector Control Methods, Materials, and Equipment

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F901 CONTRACT: WORK UNIT: 261

RAD: I TYPE OF FUNDING: 6.2 PROJ/TASK: 870AV

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Solberg, Victoria B. COR:

OBJECTIVES: Conduct exploratory development of vector control equipment and research on arthropod surveillance and control methods for use by DOD preventive medicine units. Provide technical guidance on operational capabilities and doctrine on potential vector control systems to meet Army needs.

APPROACH: Develop vector control methods and equipment for transitioning into advanced development which are compatible with the U.S. Army force structure.

PROGRESS: Contacted U.S. Army Corps of Engineers, Waterways Experiment Station, to discuss their expert system development projects. One involved the identification of aquatic plants and recommends control strategies. Because of the similarity between their expert system for aquatic vegetation and the Vector Control Advisor System (VCAS) being developed in this laboratory, further investigation into their algorithm will be pursued. Incorporation of data of mosquito species in Honduras into the VCAS is ongoing.

A manuscript on field evaluation of liquid and granular cyfluthrin (active ingredient of TEMPO2) for control of ticks is in preparation. The study results indicated that liquid cyfluthrin gave 99 percent control while granular cyfluthrin gave 89 percent control over a 78-day period.

A comparative field study between the Army Collapsible Insect Surveillance (ACIS) Trap, and New Jersey light traps is in progress at Fort Polk, LA; Fort Lewis, WA; and Norfolk, VA.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0007 28 September 1990

TITLE: Technical Feasibility Testing (TFT) of Vector Control Equipment

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F904 CONTRACT: WORK UNIT: 264

RAD: I TYPE OF FUNDING: 6.2 PROJ/TASK: 870AV

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Anderson, Leroy M. COR:

OBJECTIVES: To determine the durability of commercially available ultra-low volume and powered pesticide dispersal equipment by comparative-type engineering tests. Units will be used by military medical and engineering personnel for controlling mosquitoes and other insect pests.

APPROACH: Determine the operational capabilities of skid-mounted and special-purpose ultra-low volume pesticide dispersal equipment by quantitative and qualitative methods. Measurable quantitative parameters include particle size determination and maintenance of desired pressure and flow rate. General engineering assessment of design will be conducted.

PROGRESS: Testing for the PD-5 compression duster and the B&G pressure duster was completed for the Armed Forces Pest Management Board (AFPMB). The test results showed that both units leaked under pressure but the B&G pressure duster was comparatively better than the PD-5 compression duster. A recommendation would be made to AFPMB that these units will have very limited military use. A portable electrical sprayer and a cart-mounted electrical sprayer from Roussel Bio Corporation are being tested for the AFPMB. A test protocol has been prepared for a Vapex atomizing sprayer.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0008 28 September 1990

TITLE: Integrated Vector Control Strategies

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F906 CONTRACT: WORK UNIT: 266

RAD: I TYPE OF FUNDING: 6.2 PROJ/TASK: 870AV

REQUIREMENTS DOCUMENT: Letter of Agreement, 5 Jan 79

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Perich, Michael J. COR:

OBJECTIVES: To develop effective biorational larvicides; develop improved adulticide application techniques specifically designed to optimize vector control in field situations typically encountered in a combat zone.

APPROACH: Develop and evaluate biorational larvicides in laboratory and field studies; evaluate new chemical adulticides under field conditions.

PROGRESS: Laboratory evaluation of four insecticides (bendiocarb, malathion, permethrin and methoxychlor) as barrier sprays against Anopheles albimanus has been completed. The data is being compiled and analyzed and a manuscript on the results combined with the results of the field evaluation of barrier spraying to control malaria vectors in the Dominican Republic will be prepared. Evaluations have been completed on Cathranthus root alkaloid extraction for its effects on fertility and fecundity against An. stephensi. The data is being compiled and analyzed, and 2 manuscripts, one on the larval and adult toxicity evaluation of Bougainvillea spectabilis and Cathranthus roseus extracts against Ae. aegypti and An. stephensi, and second, the effects of these extracts on the fertility and fecundity of the same mosquito species are being prepared. A comprehensive literature review on the bionomics and control of leishmaniasis vectors indigenous to Central America has been completed. Protocols for the evaluation of barrier spraying for the control of cutaneous leishmaniasis vectors in Guatemala and resting behavior of Ae. aegypti in relation to vector control methodology development are being written.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0009 28 September 1990

TITLE: Sprayer, Hydraulic, Electric Powered (DC)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F301 CONTRACT: WORK UNIT: 003

RAD: I TYPE OF FUNDING: 6.3 PROJ/TASK: 836 KD

REQUIREMENTS DOCUMENT: Operational and Organizational Plan, 29 May 90

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Sardelis, Michael R. COR:

OBJECTIVES: To develop a small, lightweight hydraulic sprayer capable of performing tasks required by the newly organized Medical Detachment, Preventive Medicine (Entomology).

APPROACH: Through the use of military standard and commercial components, minimize the size and weight of the hydraulic sprayer. An operational capability matrix will be developed comparing weight and size to output in gallons per hour. Based on this matrix a prototype will be fabricated, and a user test will be conducted.

PROGRESS: A market investigation of DC-powered hydraulic sprayers indicated no units are currently manufactured that meet the proposed operational requirements. A prototype hydraulic sprayer powered by the electrical system of the transporting vehicles was designed and fabricated. The Operational and Organizational Plan for the sprayer was approved and the Combat Developer, the Academy of Health Sciences, has begun staffing the Required Operational Capability document. A Test and Evaluation Master Plan was drafted and forwarded to the Combat Developer.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0010 28 September 1990

TITLE: Aerosol Generator, Ultra-low Volume, Electric

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F302 CONTRACT: WORK UNIT: 002

RAD: I TYPE OF FUNDING: 6.3 PROJ/TASK: 836 KE

REQUIREMENTS DOCUMENT: Required Operational Capability, 21 Jun 88

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Sardelis, Michael R. COR:

OBJECTIVES: To develop a small, lightweight, electric aerosol generator for the newly organized Medical Detachment, Preventive Medicine (Entomology). The aerosol generator will be powered from the 12-volt battery of the supporting vehicle.

APPROACH: The electric-powered aerosol generator will incorporate the Beecomist Spray Head Model 220 and the Posi-drive Insecticide Pump. In-house resources will be used to modify the equipment to meet military specifications. After modification, the equipment will be tested to determine durability, droplet size dispersed, and capabilities for dispersal of various liquid formulations. This unit will be recommended for type classification and fielding.

PROGRESS: Technical testing (TT) of the Aerosol Generator, Ultra-Low Volume, Electric-Powered (AGULVE) was completed. A new model of rotary atomizer is being evaluated for possible incorporation into the current AGULVE. Engineering development prototypes are being fabricated for TT II and user testing by the Academy of Health Sciences for 2Q91.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0011 28 September 1990

TITLE: Reimbursable/DCSC-First Article Testing

PROPONENT COMMAND(S): Defense Logistics Agency

APC: F585 CONTRACT: WORK UNIT:

RAD: TYPE OF FUNDING: PROJ/TASK: REIMB

REQUIREMENTS DOCUMENT: U.S. Army Long Range Research, Development, and Acquisition Plan

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Anderson, Leroy M. COR: Boobar, Lewis R.

OBJECTIVES: Determine the durability of commercially available ultra-low volume and powered pesticide dispersal equipment by comparative type engineering tests. Units will be used by military medical and engineering personnel to control mosquitoes and other insect pests. Results will provide the Defense Construction Supply Center with comparative durability and reliability data which can be used to ensure purchase of the most effective equipment available.

APPROACH: As part of the procurement cycle, skid-mounted equipment and special-purpose ultra-low volume pesticide dispersal equipment are tested for compliance with quality assurance criteria of the appropriate specification.

PROGRESS: No First Article Tests were requested by the Defense Construction Supply Center during FY90. The reimbursable funds provided to this Laboratory to conduct First Article Tests were returned to DCSC.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHI-0013 28 September 1990

TITLE: Arthropod Repellent Topical Extended Duration Formula

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F326 CONTRACT: WORK UNIT: 102

RAD: I TYPE OF FUNDING: 6.3 PROJ/TASK: 808ED

REQUIREMENTS DOCUMENT: Joint Service Operational Requirement (JSOR), 27 Jul 89

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Gupta, Raj K. COR:

OBJECTIVES: Develop a longer lasting wide-spectrum topical composite repellent using state-of-the-art techniques.

APPROACH: Demonstrate concept of composite repellent and incorporate into existing extended duration topical insect/arthropod repellent.

PROGRESS: Studies were completed to determine optimum concentration of three experimental repellents (A13-37220, A13-35765, and CIC4) against Aedes aegypti, Anopheles stephensi and Culex quinquefasciatus. A Cooperative Research and Development Agreement (CRDA) was finalized with 3M Company. An animal use protocol was developed and received approval from USABRDL animal use committee. A human use protocol to investigate insect/arthropod repellent loss from skin through abrasion has been submitted for human use committee approval. A Material Transfer Agreement (MTA) was coordinated and signed with Dr. Cottrell, leader, Amazonian Expedition, Carmichael, CA; to evaluate extended duration repellent in Amazonian jungles against mosquitoes, sandflies and black flies. A new CRDA is in process of being worked out with Quest International to investigate multi-functional fragrances for their potential repellent properties. A proposal is being developed to investigate shelf life stability testing of 1% malathion dust and clothing repellent impregnant, permethrin.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

MILITARY DISEASE HAZARDS BRANCH
FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

BRDL NUMBER: MDHE-5001 28 September 1990

TITLE: Nozzle Assembly for Army Mass Delousing Outfit (SBIR 89.I)

PROPONENT COMMAND (S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD 17-89-C-9131 WORK UNIT: 164

RAD: I TYPE OF FUNDING: 802 PROJ/TASK: BA

REQUIREMENTS DOCUMENT: Department of Defense FY-90 Small Business Innovative Research (SBIR) Program

LOCATION: Cardinal Scientific, Inc., 124 Indian Court, Waldorf, Maryland 20601

PI: Burke, John W. COR: Edgecomb, Robert S.

OBJECTIVES: To design and fabricate a nozzle assembly, which consists of a storage hopper, metering device, and nozzle, powered by the Model DM-9 backpack sprayer that can distribute metered amounts of solid-formulation pediculicide to 17 sites per person.

APPROACH: Tests will be conducted to determine the DM-9's blower performance characteristics. This data will be used to select possible mechanically actuated meter designs. The best metering devices will be fabricated and tested. Further studies will be conducted to determine the design of the pediculicide storage hopper and dispersal nozzle.

PROGRESS: Five meter designs have been fabricated. The designs include a sliding gate valve at inclined or vertical orientations, a rotary hopper, a plunger piston and auger. Each meter was installed on the DM-9 and evaluated for size and duration of dust cloud, volume of dust dispensed per actuation stroke, and visual signs of blow-by or leakage. The inclined sliding gate membrane metering system was found to have negligible leakage and to be the most accurate of the five meter designs. The contract was completed on schedule. Along with the final report, two meter designs were delivered, the inclined sliding gate valve and the auger. This is the final Information Paper on this project.

THIS PAGE INTENTIONALLY LEFT BLANK.

HEALTH EFFECTS RESEARCH DIVISION

The Surgeon General's environmental protection research mission is conducted in the Health Effects Research Division of USABRDL. Investigations are pursued to assess the environmental impact of military training and industrial activities and to evaluate the risk to military and civilian populations from exposure to contaminated soil, air, or water. Information from these investigations and from scientific literature is organized into technical databases that support the establishment of safe exposure limits and industrial effluent concentrations. The USABRDL supports the Army's Installation Restoration Program (IRP) by developing methods to detect presence of military-unique contaminants and data supporting program decisions on candidate technologies. The USABRDL is also the major research asset supporting Health Hazard Assessment for Army materiel acquisitions. In a process similar to that used in environmental research, available data are accumulated and identified data gaps are filled by research to produce databases for risk assessments. This involves basic toxicological research and exposure to military equipment, materials, and industrial activities. Expertise from USABRDL is frequently sought by other military agencies to provide expert consultation and review. Within this Division, USABRDL also has a major effort in development of decontamination technology to assure safe drinking water in combat environments.

During fiscal year 1990, HERD published several manuscripts and abstracts in peer-reviewed publications. Areas covered included development of on-site biomonitoring; use of fish as biomonitors; toxicity of smokes; liquid gun propellant; oncogenes in hematopoietic and hepatic fish neoplasms; USABRDL's efforts in new toxicity assessment methods; environmental fate, effects and toxicity of nitroguanidine; toxicokinetics of the explosive RDX; use of short-term toxicity data for prediction of long-term health effects; effects of troop lead exposures; research into the ventilatory requirements of tank crewmen; health and environmental considerations related to organic explosives; and Army criteria development for active and inactive hazardous waste sites. New research was initiated in the area of new methods using biomarkers for toxicity and exposure assessment.

A Health Advisory for the propellant munition nitroguanidine was published. Health Advisory preparation was begun for 1,4-dithiane, a by-product of sulfur mustard; for isopropyl methyl phosphonate (IMPA), a degradation product of the nerve agent by-product diisopropyl methyl-phosphonate (DIMP); and for p-chlorophenyl methyl sulfide, sulfoxide and sulfone (pCPMS), soil contaminants at Rocky Mountain Arsenal, CO.

ENVIRONMENTAL QUALITY RESEARCH BRANCH

The Environmental Quality Research Branch (EQRB) plans and conducts in-house and extramural research to define environmental and health effects of military relevant materials. This involves environmental chemistry, microbiology, toxicology, zoology, botany, and engineering. This program is directed at assessing the potential hazard of discharges to fresh water and contamination of soils and ground water at Army industrial and field operations. Compound classes of interest include smokes and obscurants and conventional munitions; and the program addresses solid waste disposal, munitions demilitarization, and installation restoration. The basis for this program is found under Army Regulation 200-1 and Executive Order (EO) 11514 and EO 12088 which requires Army compliance with the National Environmental Policy Act; the Clean Air Act; the Clean Water Act; the Toxic Substances Control Act; the Resource Conservation and Recovery Act; the Comprehensive Environmental Response, Compensation, and Liability Act; the Emergency Planning and Community Right-To-Know Act; and the Superfund Reauthorization Act. To ensure that the research conducted in this program will be acceptable to federal regulatory agencies, continuous coordination is maintained with the U.S. Environmental Protection Agency. Routine coordination is also maintained with other Department of the Army and Department of Defense activities, as well as other federal agencies, so that government resources for environmental and health effects research can be effectively utilized. To ensure close cooperation in the area of environmental and health effects in the Installation Restoration Program (IRP) a Memorandum of Understanding has been in effect with the U.S. Army Toxic and Hazardous Materials Agency. Health related databases derived under the IRP influence the design of pollution abatement systems, define the hazard of military-relevant materials, and provide target concentrations for cleanup at installation restoration sites.

Surface Fresh Water Fate and Effects. Research covered under this topic is designed to develop quicker, less costly methods for evaluating the potential health and ecological effects of military-unique chemicals and chemical mixtures present in fresh water systems. Research efforts explore new methods and models to predict hazards based upon physical, chemical, and effects estimation methods; and ecological effects assessment techniques derived from these research efforts are developed and incorporated into a framework applicable to the Army's needs. Research is also conducted to assess the environmental effects and fate to provide the basis for development of treatment technologies and to minimize hazard and waste generation. The research efforts result in determination of hazards of military-unique materials in fresh water systems. The data are used in design criteria for pollution abatement and in the determination of environmental concentrations that will not lead to ecological damage or degradation and will not significantly endanger human health.

The assessment of the hazard from disposal of nitroguanidine wastewaters was completed. Generally the results indicate that this material poses no significant risk to the environment or human health.

Ground Water and Soils Fate and Effects. The objective of this work includes the development of quicker, less costly methods for evaluating the potential health and ecological effects of Army-unique chemicals and chemical mixtures present in contaminated soil and ground water at Army sites and the assessment of the impact of these materials on the exposed ecosystems. The results of the research to improve prediction and assessment of ecological and health effects are validated and incorporated into a framework applicable to the Army's needs. The results from this research will be validated and will lead to the ability to more rapidly determine the relative hazard of materials in soil and ground water at a reduced expense without sacrificing scientific validity. The research efforts result in the determination of environmental hazard of military activities. The data are used to validate new treatment technologies, as guidance in cleanup/remediation activities, and in the determination of environmental (soil and ground water) concentrations that will not lead to significant ecological damage or degradation or endangerment of human health.

A second version of a computerized model for defining the potential hazard of materials at waste sites was completed and has received broad based notice by the civilian and military community.

A study to define the movement of the explosives TNT and RDX through soils to ground water at munitions disposal areas after open burn/open detonation has resulted in explaining the high levels of ground water contamination at these sites.

The potential effects on terrestrial and aquatic biota from the use of red phosphorus smoke munitions were defined. A model to predict the deposition of smokes and obscurants under moderately complex atmospheric and terrain conditions was developed and validated.

THIS PAGE INTENTIONALLY LEFT BLANK.

INFORMATION PAPERS FOR PROJECTS ACTIVE IN FY90
ENVIRONMENTAL QUALITY RESEARCH BRANCH

THIS PAGE INTENTIONALLY LEFT BLANK.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0001 28 September 1990

TITLE: Hazard Assessment Methods Computerization

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F686 CONTRACT: WORK UNIT: 121

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Small, Mitchell J. COR:

OBJECTIVES: The objective of this effort is to create the software for a user-friendly computer system that combines elements of hazardous materials data bases, with particular attention paid to Army-relevant substances, physical/chemical property estimation methods, and approaches to predicting the adverse environmental or health effects caused by hazardous material misuse.

APPROACH: The programs will be based on the Preliminary Pollutant Limit Value approach as a central means of developing soil or water limits based on the hazards associated with chemicals. Methods of estimating physical or chemical properties of chemicals prerequisite to the approach will be included. User's manuals will be issued for all developed software.

PROGRESS: In 3Qtr FY90, software requests were received from the following persons: David Liu, ENSR Health Services, Michael Harrass, Food and Drug Administration, David McBride, Technicolor, Inc., and John Lowe, Dames & Moore, Sacramento, CA. The report was announced in the National Technical Information Service Abstract Newsletter. A poster session was presented at Armed Forces Day, and an abstract was prepared for a presentation at the Society of Environmental Toxicology and Chemistry.

All surface soil pathways in the revised software package (to be known as Version 2.0) have been completed. The type 1 and 2 constraint analyses software have been completed for these pathways. Sediment pathways were added to the program. The "fleshing in" of information messages to include default or suggested values for nonchemical data inputs was completed. These messages have to be well prepared.

In 4Qtr, FY90 the software package was completed, and is being debugged. A technical report that will serve as the users manual is being prepared. The version 1.1 document was 106 pages; this version will be larger.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0002 28 September 1990

TITLE: Environmental Fate Microbiology

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F687 CONTRACT: WORK UNIT: 122

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Bausum, Howard T. COR:

OBJECTIVES: The objectives are to define the mechanisms and kinetics of biodegradation of key nitroaromatic pollutants in 2,4,6-trinitrotoluene (TNT) processing wastewater streams.

APPROACH: The biodegradation of 2,4- and 2,6-dinitrotoluene (DNT) in environmental waters will be determined. Mixed enrichment cultures and pure bacterial strains capable of degrading each isomer will be characterized. The kinetics of DNT breakdown by mixed cultures will be studied; and pseudo-first-order and second order rates and half-lives for the chemicals will be determined. Using pure strains, intermediate products will be identified. Genetic determination and the role of plasmids will be studied. Substrate range, effect of nutritional and other factors, and enzyme kinetics of DNT breakdown will be studied in pure strains.

PROGRESS: Microorganisms isolated from surface waters below Radford Army Ammunition Plant, VA have been shown to degrade 2,4- and 2,6-DNT to carbon dioxide. Mixed enrichment cultures capable of growth on 130 parts per million DNT have been established for each isomer, with the 2,4 isomer being the more rapidly degraded. The 2,6-DNT mixed culture adapts to growth on 2,4-DNT, but the reverse does not occur. Partial characterization of the mixed cultures is in progress. The 2,6- culture contains at least four bacterial types and its composition did not appear to change on repeated passage. Pure cultures have been established that use 2,4-DNT as a sole carbon source and possible "reversion" to non-utilization is being investigated. Pure strains are being sought that transform 2,6-DNT to other compounds. For both DNT isomers, pseudo-first and second-order rate constants and half-lives have been calculated for degradation in mixed cultures. The laboratory phase of this project is at an end. A USABRDL Technical Report detailing the results is being drafted.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0003 28 September 1990

TITLE: Chemical Transformations of Nitroaromatics

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F688 CONTRACT: WORK UNIT: 123

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Burrows, Elizabeth P. COR:

OBJECTIVES: The objective is to determine the course of reaction of selected nitroaromatics in two different laboratory situations which are relevant to their fate in the environment, photochemical transformation and oxidative transformation.

APPROACH: Selected mononitro and dinitropolynuclear aromatic hydrocarbons will be photolyzed in the laboratory under conditions selected to mimic the effect of sunlight on pollutants dissolved in natural waters. The photoproducts will be isolated and separated by various chromatographic techniques and identified on the basis of their mass spectra and other characteristic properties. The mixtures resulting from photooxidation and other oxidative transformation processes will be separated and the products identified in a similar manner.

PROGRESS: Of the four nitroaromatics selected for study, three were unchanged on prolonged treatment under conditions which resulted in rapid phototransformation of 2,4,6-trinitrotoluene. A fourth was phototransformed slowly but no discrete products could be characterized. It is believed that the ability to form an anion readily may be a requisite for phototransformation. This investigation has proven unproductive. A DD Form 1498 was filed and the work unit was terminated on 29 December 1989.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0004 28 September 1990

TITLE: Metabolism Studies on Munition Chemicals

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F683 CONTRACT: WORK UNIT: 129

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reddy, Gunda COR:

OBJECTIVES: This research will investigate the toxicokinetics of selected munitions compounds with the following aims: (a) to study absorption, tissue distribution and elimination of munition chemicals by different routes of administration; (b) to compare metabolic fate of a chemical by administering intratracheally and orally, where gut microflora and other factors might affect the metabolism; and (c) to study the metabolism of chemicals in vivo and in vitro and to identify possible metabolites.

APPROACH: Radiolabeled hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) will be administered intratracheally to rats. At specified times, excreted urine, feces and expired carbon dioxide will be collected and analyzed for possible metabolites. Absorption and tissue distribution of RDX will be determined.

PROGRESS: Metabolism of 14C-RDX (15 mg/kg) was studied in rats following intratracheal administration. The radioactivity levels in urine, feces and tissues were measured at 4 and 6 days in female and male rats. Urine and feces were extracted with organic solvents for identification of possible metabolites.

Preliminary 14C-RDX metabolism studies were also conducted in rats to measure expired CO_2. Urine, feces and expired CO_2 were collected at 24 and 48 hrs. Blood and various tissues were collected at the termination of experiments. The results show that about 17 percent and 9 percent of administered dose was eliminated in expired air and about 19 percent and 13 percent of dose was eliminated in urine of female and male rats respectively in 48 hours. About 2 percent of dose was eliminated in feces of female and male rats. Analysis of blood showed about 0.02 percent of the dose was present in the plasma after 48 hours. The radioactive residues in tissue (liver, kidney, heart and lung) at 48 hours were 0.2 to 0.7 percent of the dose.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0006 28 September 1990

TITLE: Installation Restoration Assessments

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F689 CONTRACT: WORK UNIT: 131

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Small, Mitchell J. COR:

OBJECTIVES: The research is designed to expand the scope and applicability of assessment methods developed in-house (particularly the Preliminary Pollution Limit Value methodology), to develop the scope of research projects and to perform in-house research to improve the methods for determining and increasing the data base of important physical or chemical properties of compounds of concern in Installation Restoration situations.

APPROACH: Ongoing installation restoration problems in which the U.S. Army Toxic and Hazardous Materials Agency or the U.S. Army Environmental Hygiene Agency are involved will be monitored for assessment situations that have research potential. Research requirements will be defined and the method of performance determined. Specific in-house research tasks will be reported as separate projects.

PROGRESS: None. This work unit has been discontinued and will be the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0007 28 September 1990

TITLE: Installation Restoration Assessments - Environmental Chemistry

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F690 CONTRACT: WORK UNIT: 132

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Major, Michael A. COR:

OBJECTIVES: The objective is to compile and/or develop a data base of octanol/water partition coefficients for military relevant chemicals found in ground water under the Army's Installation Restoration Program. This work was formerly conducted under Accession Number DA313544. A literature search was conducted under Defense Technical Information Center Number 060637, dated 29 February 1988, for the Technical Report data base and 04P14J, dated 15 August 1989, for the work unit data base. The proposed effort will not result in the duplication of effort.

APPROACH: The approach includes acquisition of accurate values for octanol/water partition coefficients by the combination of literature searches, estimation methods, and laboratory experiments. All funds applied to this in-house research effort are reimbursable funds provided by the U.S. Army Corps of Engineers (USACOE).

PROGRESS: Initial studies on the physical properties of military significant compounds are completed. Reports on the octanol/water partition coefficient of the compounds on the U.S. Army Toxic and Hazardous Materials Agency list of important military site pollutants was completed and published (USABRDL Technical Report Number 8810). Experiments to determine the octanol/water partition coefficient of methylmercuric compounds under a variety of salinity conditions were completed. The manuscript on the octanol/water partition of methylmercuric compounds was reviewed and accepted for publication in the December 1990 edition of the Society of Environmental Toxicology and Chemistry (SETAC) Journal. The work was also accepted for presentation at the 1990 USACOE meeting at Williamsburg, VA and the SETAC meeting in Crystal City, VA.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0008 28 September 1990

TITLE: Environmental Criteria Documentation

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F684 CONTRACT: WORK UNIT: 130

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Mitchell, Wayne R. COR:

OBJECTIVES: The objective is to derive water quality criteria for the protection of both aquatic life and human health, and to identify data gaps and made recommendations regarding future research using current U.S. Environmental Protection Agency (USEPA) methodologies.

APPROACH: Information in the open literature and in Government reports, especially those of Department of Defense agencies and their contractors, will be obtained through appropriate search strategies. Current work will be considered by contacting appropriate researchers. In-house staff in toxicology, chemistry, and environmental assessment will participate in evaluation of the information and criteria derivations. Where data are adequate, water quality criteria for the protection of human health and aquatic life will be calculated following USEPA methods. Research needs will be identified.

PROGRESS: Review of literature pertaining to the health and environmental effects of elemental red phosphorus has been conducted and individuals associated with red phosphorus obscurant munitions production have been contacted. The element is not produced by the Army but is purchased from abroad and used at Pine Bluff Arsenal in the loading and assembly of munitions. Other than fire hazards associated with older, poorly functioning smoke grenades (L8A1), no adverse environmental impact has been identified which is associated with the element. It is not significantly toxic, and as an insoluble polymer used terrestrially, water quality criteria are not appropriate for elemental red phosphorus. A DD 1498 for the termination of the work unit was filed and project was terminated in November 1989. Write-ups prepared in the course of the information search addressing production, military use, chemical properties, and environmental fate of red phosphorus have been provided to a USABRDL investigator for the red phosphorus associated fire hazard in support of a possible presentation regarding the L8A1 grenade. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0009 28 September 1990

TITLE: Bioeffects Monitoring for Munitions: System and Probe Development

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F692 CONTRACT: WORK UNIT: 271

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Mitchell, Wayne R.
Burrows, Elizabeth P.

COR:

OBJECTIVES: The objective is to establish an experimental system for the generation, estimation, and study of bioreactive intermediates formed from U.S. Army munitions and to utilize that system for the development of data bases and exposure probes.

APPROACH: A continuous mammalian cell line with inducible microsomal monooxygenases will be identified and established in the laboratory. The cell system will be exposed to various nitroaromatic munitions pollutants. Intermediates produced during exposure will be isolated and identified. Effects on monooxygenase induction by the munitions will be studied as will effects on antioxidant defense enzyme systems.

PROGRESS: A tissue culture facility for the propagation of the mammalian cells to be used in the project has been established and is functioning. Rat liver hepatoma H4IIE cells, a line in which the induction of monooxygenases has been reported, have been obtained and are being successfully propagated. Efforts to freeze the cell stocks for future use have been initiated and will continue. Instrumentation for chemical, biochemical, and molecular analysis of cellular metabolites and biomolecules is being assembled. Assays for catalase and superoxide dismutase are being standardized and activity for both enzymes has been demonstrated in the hepatoma cells. Attempts to induce cytochrome P-450 monoxygenases have been initiated.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRI-0010 28 September 1990

TITLE: Toxicokinetics and Metabolism of 1,3,5-Trinitrobenzene in Rats

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F683 CONTRACT: WORK UNIT: 129

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Reddy, Gunda COR:

OBJECTIVES: The objectives are to investigate the toxicokinetics and metabolism of 1,3,5-Trinitrobenzene (TNB) in rats. These studies will be directed to accomplish the following aims: (a) to determine absorption, tissues distribution and elimination of TNB when administered orally, and (b) to study the metabolism of TNB in vivo and in vitro and to identify possible metabolites.

APPROACH: 14C-TNB will be administered by oral gavage to rats and these will be placed in the metabolism cages. The urine, feces and expired CO2 will be collected to determine the presence of TNB or its metabolites. At the termination of experiments, blood and various tissues will be taken for the analysis of 14C-TNB or its metabolites. Urine and feces samples collected on different days will be extracted with organic solvents and analyzed for the presence of TNB or its metabolites. In vitro metabolism experiments with rat liver slices or microsomal enzyme systems will be carried out to obtain information about the metabolic pathways involved in the metabolism of TNB.

PROGRESS: Radiolabeled TNB has been ordered from New England Research Products by custom synthesis. Protocols to use radioactive compounds at the U.S. Army Medical Research Institute of Infectious Diseases have been approved. Animal use protocols are being prepared for approval. Experiments will be started upon receipt of 14C-TNB.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5001 28 September 1990

TITLE: Field Measurement and Model Evaluation Program for the Assessment of the Environmental Effects of Military Smokes

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F640 CONTRACT: 84PP4822 WORK UNIT: 291

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 291

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Energy, Argonne National Laboratory, Argonne, IL

PI: Policastro, Anthony J. COR: Young, John Y., MAJ

OBJECTIVES: To develop mathematical models and chemical sampling techniques applicable to predictions of the environmental impact of deposited smoke material on the soil, water, and plant and animal life indigenous to areas where smokes are employed.

APPROACH: Mathematical modeling and chemical sampling techniques will be evaluated in a series of progressively complex terrain and meteorological situations. The first field trials will utilize the existing smoke modeling facilities of the U.S. Army Dugway Proving Ground (DPG) to understand the downwind dispersion of fog oil generated by a standard U.S. Army tactical smoke generator. The field trials at DPG will focus on collecting smoke dispersion data that are useful to safisfactorily predict fog oil concentrations at some points of interest downwind. Based upon the understanding gained from these trials, subsequent protocols will be defined for more complex terrain modeling and for different smokes in the Army inventory.

PROGRESS: Five final reports were delivered as of 7 December 1989. Atmospheric dispersion Gaussian models were found to overpredict the actual conditions within a factor of 2 or 3. Improved over these models is a stochastic model developed as a product of this project, which included considerations of the effects of thermal convection. Fog oil smoke was found to exist as 99 percent droplets with a lognormal particle size distribution. Hexachloroethane smoke was 90 percent particulate, with a bimodal particle size distribution. Both fog oil and HC were developed and simplified, with improved specificity and accuracy. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5002 28 September 1990

TITLE: Evaluate and Characterize Mechanisms Controlling Transport, Fate and Effects of Army Smokes in the Aerosol Wind Tunnel

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F625 CONTRACT: 84PP4819 WORK UNIT: 013

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Energy, Pacific Northwest National Laboratory, Richland, WA

PI: Van Voris, Peter COR: Mitchell, Wayne R.

OBJECTIVES: The objective is to define the fate and effects of Army obscurants in the environment including smokes generated from white phosphorus (WP), red phosphorus (RP), fog oil (FO), hexachloroethane (HC), and a mixture of the above.

APPROACH: Obscurants were aerosolized in a wind tunnel and their physical/chemical properties were determined under varying conditions of wind speed and humidity. Likewise, the effects of the obscurants were measured on selected plant and animal species and microbial processes.

PROGRESS: Documentation of the WP/RP, FO, and HC smoke projects conducted previously is now complete and all reports are in final printed form. A final report defining Mixed WP/FO/HC smokes, the last report for the project order, was received, reviewed, and approved by USABRDL Staff and was received by the Laboratory in final printed form in January 1990. All elements of the project order were then complete and all deliverables had been received. A completion form DD 1498 was submitted at that time.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5003 28 September 1990

TITLE: Health Advisories on Munition Chemicals

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F626 CONTRACT: 85PP5869 WORK UNIT: 020

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Environmental Protection Agency, Office of Drinking Water, Washington, DC

PI: Khanna, Krishan COR: Bausum, Howard T.

OBJECTIVES: The objectives are to prepare preliminary toxicology profiles on selected military-relevant compounds; to develop Health Advisories (HA) for selected compounds in drinking water; to define significant data deficiencies and to provide recommendations for future research; and to establish regulatory agency acceptance of Department of Defense (DOD)-sponsored studies and discharge recommendations.

APPROACH: Technical reports and publications from DOD-sponsored studies will be obtained and supplied, along with summaries of the information, to the U.S. Environmental Protection Agency (USEPA). The USEPA will obtain information available in the open literature. The USEPA will review and evaluate the information, calculate health advisory levels, and prepare the HA documents for review, including external peer review. The Advisories will be published as USEPA documents and listed in the Federal Register.

PROGRESS: Data generated by DOD agencies and their contractors have been submitted to USEPA on over 15 compounds: nitrocellulose, nitroglycerin, 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro 1,3,5,7-tetrazocine (HMX), diisopropyl methylphosphonate (DIMP), nitroguanidine, white phosphorus (WP), hexachloroethane (HC), $ZnCl_2$, 2,4- and 2,6-dinitrotoluene (DNT), dimethyl methylphosphonate (DMMP), 1,3-dinitrobenzene (DNB), dithiane, and p-chlorophenyl methyl sulfur compounds. The HA on the first 7 substances have been completed and published, and copies supplied to numerous requestors. Five additional draft HA have been reviewed at USEPA and this Laboratory: WP, HC, $Zncl_2$ DMMP and DNB. The HA on DNTs is undergoing review at this Laboratory. Drafting of the HA on IMPA has begun. Preliminary toxicology profiles have been submitted on a number of additional priority substances.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5004 28 September 1990

TITLE: Toxicity of Nitroguanidine, Nitroglycerin, Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and 2,4,5-Trinitrotoluene (TNT) to Select Freshwater Aquatic Species

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F634 CONTRACT: 88MM8501 WORK UNIT: 005

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Navy Space and Naval Warfare Systems Command, Johns Hopkins University Applied Physics Laboratory, Laurel, MD

PI: Burton, Dennis T. COR: Major, Michael A.

OBJECTIVES: The objective is to complete the existing data base for deriving numerical water quality criteria for freshwater organisms exposed to nitroguanidine (NQ), trinitroglycerin (TNG), Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and 1-methyl-2,4,6-trinitrobenzene (TNT).

APPROACH: The freshwater toxicity data base for NQ, TNG, RDX, and TNT is to be completed using standard methodologies recognized by the U.S. Environmental Protection Agency. Those data will then be used to develop criterion maximum concentrations and criterion continuous concentations, both of which are required to develop numerical water quality criteria for these compounds.

PROGRESS: This project is a series of experiments designed to set the acceptable levels of RDX, TNT, NQ, and nitroglycerin. To do this, the investigator must expose several species of plants and animals to varying concentrations of these munitions for various lengths of time, during critical periods of their life cycle. During 3Q, FY90 the 48-h Ceriodaphnia test with NG was completed, as was the 7-d testing with this species. The 60-d ELS test with rainbow trout exposed to NG was also completed. The fathead minnow cycle test with TNT was completed 1 July 1990. For 4Q, FY90, the 96-H LC50 fathead minnow test with NG was completed. The fathead minnow ELS test with NG is underway as are the photo-NQ and photo-RDX tests with C. dubia.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5006 28 September 1990

TITLE: Effect of Nitroguanidine-Contaminated Wastewater on Physiology of Plants

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F628 CONTRACT: 87PP7815 WORK UNIT: 292

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Agriculture - Agriculture Research Service, Fort Detrick, Frederick, MD

PI: Hodgson, Richard COR: Burrows, Elizabeth P.

OBJECTIVES: The objective is to determine uptake and distribution of nitroguanidine (NQ) in selected plants, to determine toxicity levels, to determine its effects on plant growth and physiology, and to study the metabolism of NQ in both NQ-sensitive and NQ-resistant plant species.

APPROACH: Selected species of plants will be grown, both in hydroponic culture and in soils, in the presence of varying concentrations of NQ or NQ-containing water. Uptake and distribution of radiolabeled NQ in the plant tissue will be determined, and possible metabolites will be sought. Effects on biomass production, reproductive capacity, and such physiological parameters as photosynthesis and respiration will be determined. Indicators of toxicity such as chlorosis will be monitored.

PROGRESS: A DD Form 1498 was filed and work unit was terminated on 29 December 1989. In lieu of a final report, reprints of the paper cited below were provided.

Heitholt, J.J.; R.H. Hodgson, and T.J. Tworkoski. 1989. Toxicity and uptake of nitroguanidine in plants. Bull. Environ. Contam. Toxicol. 40:751-758.

SEMIANNUAL INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5007 28 September 1990

TITLE: Environmental Health Effects of Army Materials

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F683 CONTRACT: LAIR WORK UNIT: REIMB

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: Letterman Army Institute of Research (LAIR), Presidio of San Francisco, CA

PI: Korte, Don W. COR: Reddy, Gunda

OBJECTIVES: The objective is to develop the mammalian toxicological data base to aid in predicting potential human health effects from environmental exposure to chemicals, explosives, propellants and smoke and obscurant materials that are of significance to the Army.

APPROACH: The project involves the testing of nitroguanidine (NQ) or its intermediates/by-products in a battery of acute, special toxicity and mutagenicity tests. Subchronic, reproductive, developmental and metabolic fate studies will be conducted with NQ and its most toxic degradation products. The compounds being tested are NQ, guanidine, guanidine nitrate and nitrosoguanidine.

PROGRESS: The results showed that NQ was not toxic to rats and mice (oral LD50 is greater than 5 g/kg), was nonirritating to eyes and skin of rabbits and did not produce dermal toxicity and skin sensitization in animals. Genotoxicity studies also showed negative in Ames and mouse lymphoma assays. NQ did not produce developmental toxicity in rats, rabbits reproductive fertility effects in rats at doses of 100, 316, and 1000 mg/kg. In 90-day feeding studies, in rats and mice 100, 316, and 1000 mg/kg also showed no toxic effects at lower doses. The no observed effect levels in rats was 316 mg/kg. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5008 28 September 1990

TITLE: Behavioral-Physiological Effects of Red Phosphorus Smoke Inhalation on Two Wildlife Species

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F624 CONTRACT: 85PP5847 WORK UNIT: 003

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Agriculture, Fish and Wildlife Service, Denver Wildlife Research Center, Denver, CO

PI: Thompson, R. Daniel COR: Gardner, Henry S.

OBJECTIVES: This research is projected to provide information on the behavioral and selected physiological effects of acute high level exposures of red phosphorus/butyl rubber (RP/BR) smoke to the black-tailed prairie dog and the rock dove, two common western wildlife species.

APPROACH: Baseline physiological parameters will be determined in the test animals and the animals will be trained to several tasks whose accomplishment, or decrement thereof, is relevant to the survival of the animals. The animals will be exposed to RP/BR smoke at levels determined in range-finding studies and subsequently tested for changes in these parameters.

PROGRESS: Aerosol characterization work has been completed and a final report on this aspect of the research has been published. A final report on the baseline physiological parameters of interest in both species has also been completed and published. The final report on the RP/BR effects on the selected parameters in both species has been completed and distributed. The rock dove demonstrated greater sensitivity to RP/BR aerosols than the prairie dog. This was seen in mortality, spontaneous activity, startle response (females), and blood chemistry. The prairie dog was essentially unaffected (with exception of a transient hoarse bark) by the RP/BR. The rock dove results, however, appeared to suggest that avian species may be a sensitive group of concern to training area managers. This is the final Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5009 28 September 1990

TITLE: Fate of Munitions in Composting

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F637 CONTRACT: 89C9031 WORK UNIT: 015

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: University of Nebraska, Lincoln, NE

PI: Nelson, Darryl W. COR: Mitchell, Wayne R.

OBJECTIVES: The objective is to evaluate the chemical transformations, mass balance, and toxicant formation which occur during the composting of 1-methyl-2,4,6-trinitrobenzene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in a laboratory scale system under varying conditions of operation.

APPROACH: Compost piles containing labeled TNT or RDX will be incubated and aerated in a closed laboratory scale system. All aerosol emissions will be monitored for labeled carbon dioxide and volatile organics. The compost pile will be sampled and assayed for chemical species and toxicity. Following the successful establishment of the system, operational parameters including nutrients, moisture, temperature, and chemical levels will be varied and levels of transformation products and toxicity will be measured.

PROGRESS: After a review of ongoing projects in composting and additional changes brought about by the September 1989 U.S. Army Compost Workshop, a management decision was made in December 1989 to terminate the project. The performer was notified of the decision to terminate this project by the Army's Contract Specialist. Progress for the project at the time of termination included the development and operation of a laboratory composter. In accordance with the termination negotiation and modified scope of work, the principal investigator documented the progress with a report to be accepted for internal use at this Laboratory. A termination Form DD 1498 was submitted and the project was terminated on 31 March 1990. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5010 28 September 1990

TITLE: Fate of Colored Smoke Dyes

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F644 CONTRACT: 88PP8863 WORK UNIT: 014

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Environmental Protection Agency - Environmental Research Laboratory, Athens, GA

PI: Garrison, Arthur W. COR: Burrows, Elizabeth P.

OBJECTIVES: The objectives are to define the fate of solvent and disperse dyes in natural waters, soils, and sediments and to identify the physical and chemical parameters needed to predict their behavior in the environment.

APPROACH: Solvent and disperse dyes of importance to the Army will be obtained and purified, and their physical/chemical properties will be determined. Their partition coefficients in octanol-water and sediment systems will be measured. Biotic and abiotic transformation pathways likely to influence the substances in the environment will be identified through laboratory studies, and the rates of the major fate processes will be determined.

PROGRESS: Measurement of soil-water partition coefficients, has been completed and can be summarized as follows. Sediment/soil K_{OC}'s have been estimated for all of the smoke dyes. The measured K_{OC}'s for two dyes suggest that, in the absence of cation exchange, the calculation provides reasonably reliable estimates of sorption. Photolysis studies and fate studies of the dyes are still in progress, and fate studies of aromatic amines are continuing.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5012 28 September 1990

TITLE: An Evaluation of the Environmental Fate and Behavior of Munitions Materiel (TNT, RDX) in Soil and Plant Systems

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F635 CONTRACT: 88PP8853 WORK UNIT: 279

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Energy, Pacific Northwest National Laboratory, Richland, WA

PI: Cataldo, Dominic A. COR: Mitchell, Wayre R.

OBJECTIVES: The objective is to determine the fate and bioavailability of munitions and munitions waste products in the soil environment and to determine their uptake and distribution in plants.

APPROACH: Degradation and transformation rates of 2,4,6-trinitrotoluene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in soil will be determined and products will be identified to establish bioavailability. Once bioavailability is established, uptake will be measured and the distribution of the parent compounds and their metabolites will be determined in various plant tissues.

PROGRESS: The final printed report for the first phase of this project addressing the bioavailability of TNT and its uptake by plants has been forwarded. A draft report defining the results of RDX plant uptake studies has been submitted, approved, and returned to the performer for final editing and printing. Studies on the fate and plant uptake of tetryl have been initiated. With slight modification, extraction and analytical methods developed for TNT are applicable to tetryl. Four major tetryl transformation projects have been identified in soil after 8 days of incubation. With one exception, significant toxicity of tetryl to plants has not been observed up to 60 mg/Kg soil after 30 days exposure. The exception, bush beans, shows an apparent toxic response at 10 mg/Kg in three different soil types.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5013 28 September 1990

TITLE: Environmental Studies at Open Burning/Open Detonation Disposal Sites

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F645 CONTRACT: 89PP9914 WORK UNIT: 306

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Army Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, MD

PI: Wentsel, Randall S. COR: Major, Michael A.

OBJECTIVES: The objective is to determine the toxicity of soils and soil leachates taken from Open Burn/Open Detonation (OB/OD) sites and to identify OB/OD constituents and determine their potential vertical migration and further transformation in the environment.

APPROACH: Surface soil and core samples will be collected by the U.S. Army Chemical Research, Development, and Engineering Center (CRDEC) and sent to this Laboratory. The Environmental Quality Research Branch will identify and quantitate residual munitions and also combustion products and environmentally modified forms of these compounds. In later experiments, core samples will be leached with water and the vertical movement of the OB/OD products measured. In addition, toxicity of soils from each site will be examined by monitoring the condition and growth of earthworms. Toxicity of soil leachates will also be determined in a series of EC50 experiments with Daphnia and in growth studies on algae. This work is collaborative between this Laboratory and CRDEC.

PROGRESS: Analysis of soil cores and leachates from Radford Army Ammunition Plant (RAAP) were completed in September 1990. Samples of OB/OD ash from Milan Army Ammunition Plant have been analyzed and column leaching commenced in July 1990. Collection of soil corings from the Pueblo Army Depot was completed in June 1990. Initial leachate samples from Milan Army Ammunition Plant have been analyzed. They do not suffer from low munition concentration and high concentration of interfering substances as did the leachates from RAAP. A first draft of a procedure paper outlining the methods that was developed for this work has been prepared and sent to principal investigator.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5014 28 September 1990

TITLE: Risk Assessment

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F656 CONTRACT: 88PP8864 WORK UNIT: 023

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Environmental Protection Agency, Office of Drinking Water, Washington, DC

PI: Khanna, Krishan COR: Bausum, Howard T.

OBJECTIVES: The objectives are to review the literature addressing the use of less-than-lifetime toxicology data and pharmacokinetic studies in the development of Reference Dose (RfD) or Allowable Daily Intake (ADI) levels; to identify promising relationships between lifetime data and short-term or pharmacokinetic data in RfD/ADI predictions and to develop recommendations to U.S. Environmental Protection Agency (USEPA) regarding Health Advisory (HA) development where chronic data are not available.

APPROACH: The literature on use of short-term or pharmacokinetic data to generate no-effects-levels and ADIs will be reviewed. Promising approaches in the absence of chronic toxicology data will be tested. Criteria will be developed for statistical validation and testing of the predictive capability of methods using short-term data. Recommendations will be made regarding the use and limitations of promising approaches for HA development in the absence of chronic toxicology data.

PROGRESS: A literature evaluation has been completed. A report on this phase of the work, entitled "Use of Limited Toxicology Data in Risk Assessment" has been received. This was also published as part of a symposium contribution by USEPA personnel. Promising approaches using limited or short term toxicology data have been assessed through the use of information on selected groups of substances chosen as models, and a report presenting the results is in draft. Similarly, substances have been chosen to study the use of pharamacologic data in risk assessment. Final reports on both the limited toxicology and pharmacokinetics phases of the study have been prepared, and reviewed by USEPA and this Laboratory. Problems have been addressed through appropriate consultation, and the reports are being finalized.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5015 28 September 1990

TITLE: Evaluation and Characterization of Mechanisms Controlling Fate and Effects of Army Smokes

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F638 CONTRACT: 89PP9903 WORK UNIT: 033

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Energy, Pacific Northwest National Laboratory, Richland, WA

PI: Van Voris, Peter COR: Mitchell, Wayne R.

OBJECTIVES: The objective is to define the fate and ecological effects of the brass flakes and brass flakes-fog oil obscurant systems when deployed in a wind tunnel microcosm.

APPROACH: The research approach will entail generation of the brass flakes obscurant alone or in conjunction with fog oil in a wind tunnel under various meterological conditions. The physical and chemical properties of the smokes will be assessed. Deposition rates on and toxic effects to plants will be determined, as will be effects on soils, microbial processes, and earthworm viability. Brass flakes in soil will be weathered, and the effects of weathered brass on plant growth, microbial processes, and earthworms will be measured.

PROGRESS: Aerosol exposures of plants, soils, microorganisms, and earthworms to brass flakes combined with fog oil have resulted in no change in the toxicity and effects of the brass obscurant. Deposition of brass to surfaces is likewise unaffected by the presence of fog oil. Weathering studies employing neutron activated brass have indicated that despite weathering, copper and zinc components are not mobile in soil columns. All experiments for the project are complete, a draft final report has been reviewed and approved, and receipt of the final printed report is anticipated in 4Qtr, FY90. Upon receipt of the report, a completion Form DD1498 will be submitted. This is the final information paper for this project order.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5016 28 September 1990

TITLE: TNT Metabolites in Animal Tissues

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F641 CONTRACT: 88PP8866 WORK UNIT: 034

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN

PI: Shugart, Lee R. COR: Small, Mitchell J.

OBJECTIVES: The objectives of this research are to provide the methodology to analyze for 2,4,6-trinitrotoluene (TNT) and its metabolites at 0.1 mg/kg levels in game animals (deer, rabbit, quail) and to analyze game animal flesh from TNT-contaminated Army sites for accumulation of the compound/metabolites.

APPROACH: Methods of tissue analysis for TNT and its metabolites, including statistically valid sampling, homogenization and extraction of tissues, cleanup of extracts, and analysis of extracts by radiographic, chromatographic and mass spectral techniques will be developed. Authentic samples of potential metabolites will serve as analytical standards. The investigators will ascertain the degree to which game animals become contaminated by TNT or (via ingested plants) its metabolites.

PROGRESS: The interpretation of all tissue analyses is completed and the draft final report is being prepared. The Principal Investigator has submitted an abstract proposal to present at the Army Environmental Research and Development Symposium at Williamsburg, VA and plans to give a lecture on the work at this Laboratory.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5017 28 September 1990

TITLE: Characterization of Explosives Processing Waste Decomposition Due to Composting

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F649 CONTRACT: 89PP9921 WORK UNIT: 308

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN

PI: Griest, Wayne H. COR: Burrows, W. Dickinson

OBJECTIVES: The objectives are to evaluate the environmental efficacy of composting when used to treat munitions contaminated soils and sediments and to identify toxic munitions compost products and their generation during the treatment process.

APPROACH: Samples of munitions contaminated thermophilic and mesophilic compost from the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) sponsored field demonstrations will be obtained by the performer. The samples and their leachates will be evaluated for toxicity and mutagenicity in a battery of biological test systems. Chemical substances responsible for toxicity will be identified.

PROGRESS: Phase I of the project, testing of thermophilic and mesophilic compost samples from a technology demonstration sponsored by USATHAMA at Louisiana Army Ammunition Plant is completed. The final report has been approved, published and distributed. Results indicate that little toxicity and mutagenicity is leached from compost residues by U.S. Environmental Protection Agency (USEPA) recommended acid rain simulants. Based on extractions with organic solvents, it is concluded that there are no hidden reservoirs of toxicity in the samples. Phase II of this project calls for analysis of composts from a full-scale field demonstration at Umatilla Army Depot Activity, Hermiston, OR, to begin in September 1990. Preliminary to this study, the performer has completed work necessary to achieve USATHAMA quality control (QC) certification. Further QC work will be conducted on composited compost samples provided by a USATHAMA contractor.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5019 28 September 1990

TITLE: The Leachability Characteristics of Army Explosives

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: TBD CONTRACT: TBD WORK UNIT: TBD

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: Pacific Northwest Laboratories, Richland, WA (proposed)

PI: Ainsworth, Calvin C. (proposed) COR: Small, Mitchell J.

OBJECTIVES: This research is designed to study the leaching of Army energetic compounds substances from soil to water, and to develop a model of this process in terms of soil property parameters. The derived model will try to account for temperature, concentration, and possible interactions if more than one compound is present in soil. The end result of this work will be a more reliable predictor of leachability in soil-organic carbon poor soils (such as in aquifers) than is now in use.

APPROACH: This work will be performed in two phases. In the first phase, soil-water systems involving several different soils will be selected for the determination of adsorption/desorption isotherms of 2,4,6-trinitrotoluene (TNT) and cyclotrimethylene trinitramine (RDX). These explosives will be tested at different concentration levels, as single or dual contaminants. Possible biological or photochemical effects which could act to confound results will be factored out. The isotherm results will be fitted to a model based on soil properties. In the final phase, the model derived will be validated with desorption tests with other soils and these explosives. This model, if successful, will be extended to soil-water test systems with other explosives or propellants of interest for further validation.

PROGRESS: Proposals for the "Leachability Characteristics of Army Explosives" were received from U.S. Army Corps of Engineers Waterways Experiment Station and the Battelle Pacific Northwest Laboratories. These proposals were evaluated, and that of Battelle chosen for funding subject to negotiation or clarification of some minor points. A Form 9 funding proposal is planned in 1Qtr, FY91. This is the first information paper on this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5021 28 September 1990

TITLE: Acute Mammalian Toxicity Studies on 1,3-Dinitrobenzene, 1,3,5-Trinitrobenzene, and Tetryl

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F683 CONTRACT: DAMD 17-89-C-9221 WORK UNIT:

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: Toxikon, 225 Wildwood Avenue, Woburn, MA 01801

PI: Lilja, Herman S. COR: Reddy, Gunda

OBJECTIVES: The objective is to develop the mammalian toxicological data base for assessing the possible health and environmental hazards of dinitrobenzene (DNB), trinitrobenzene (TNB) and tetryl released in the environment at Army Ammunition Plants.

APPROACH: This project involves testing of chemicals in a battery of acute toxicity tests according to U.S. Environmental Protection Agency (USEPA) Health Effects Testing Guidelines in compliance with Good Laboratory Practices.

Tests to be performed include primary eye irritation in rabbits, primary dermal irritation in rabbits, dermal sensitization in guinea pigs, acute dermal toxicity test in rabbits, acute oral toxicity LD50 test in rats and acute oral toxicity LD50 test in mice.

PROGRESS: Primary eye and skin irritation tests, acute dermal toxicity tests in rabbits and dermal sensitization tests in guinea pigs have been completed with DNB, TNB and tetryl. These compounds were found not to be skin irritants or dermal sensitizers but showed positive (DNB) to severe (TNB, tetryl) eye irritation potentials. TNB and tetryl did not produce toxic effects while DNB produced toxic effects (deaths) at 2 g/kg when applied to skin for 24 hours. Dermal LD50 values of DNB were 1.99 g/kg to rabbits. Oral toxicity tests with DNB, TNB and tetryl with rats and mice are in progress.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5022 28 September 1990

TITLE: Assessment and Computerized Modeling of the Environmental Deposition of Military Smokes

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 90PP0819 WORK UNIT: 056

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1988

LOCATION: U.S. Department of Energy, Argonne National Laboratory, Argonne, IL

PI: Policastro, Anthony J. COR: Young, John Y., MAJ, MS

OBJECTIVES: The objectives are to analyze existing field smoke dispersion data and to refine mathematical models. As a result, this will also improve the stochastic model by expanding its capability to consider stable atmospheric conditions and effects due to complex terrain; and to develop a personal computer model program for field application. Feasibility of research on multiple/mobile smoke sources will also be investigated.

APPROACH: This two-year project will begin with a thorough analysis of the AMADEUS and Camp Atterbury data. Suitable models to validate the AMADEUS data will be identified and evaluated, primarily to refine the stochastic model that has already been developed. Computer assisted evaluation of dispersion models will be simplified to allow application using a personal computer. Templates for various areas where smoke is frequently used will be made. The developed software program will be refined to take into account variables such as stable dispersion, complex terrain, and concentration fluctuations. A literature search will be performed to investigate the feasibility for further research to evaluate multiple/mobile source configurations.

PROGRESS: The PI has archived and evaluated the AMADEUS field data, and as a result, provided USABRDL a draft final report. This report has been reviewed by USABRDL and comments were subsequently furnished to the PI for revision before final publication. Analysis of instantaneous concentration measurement of the Camp Atterbury field data to complement the AMADEUS field data had begun. Dispersion model validation with the data collected at Camp Atterbury is also in progress.

SEMIANNUAL SUMMARY INFORMATION, FY90

ENVIRONMENTAL QUALITY RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: EQRE-5023 28 September 1990

TITLE: Toxicity Study of Diisoprophyl Methylphosphonate (DIMP) in Mink

PROPONENT COMMAND(S): U.S. Army Materiel Command

APC: CONTRACT: 90PP0825 WORK UNIT: NEW

RAD: III TYPE OF FUNDING: REIMB PROJ/TASK: REIMB

REQUIREMENTS DOCUMENT: Letter, AMXRM-PM, DA Program, Manager for Rocky Mountain Arsenal, 4 Apr 90, subject: Preparations for a New DIMP Study. Letter, SGPS-PSP-O, DA/OTSG, 16 Apr 90, subject: Diisopropyl Methylphosphonate Evaluation, with 1st End.

LOCATION: National Center for Toxicological Research, (NCTR), Jefferson, AR

PI: Bucci, Thomas J. COR: Dacre, Jack C.

OBJECTIVES: The research objective is to repeat a chronic feeding study as originally carried out to include a one-session reproductive cycle. The original chronic toxicity feeding study of DIMP began with 120 immature dark variety mink (approximately 3 months of age) and continued through one reproductive season of 12 months total duration. Four groups of 30 randomly selected animals (6 males and 24 females per group) were used. The concentrations of DIMP in the diet per group were: 0 (control); 50; 150; and 450 ppm. During the reproductive cycle, the females were housed individually in breeder cages.

APPROACH: The chronic toxicity study of DIMP in mink will be developed under four major tasks. Task one is the feasibility study. Task Two is the project development phase. Task Three is the dose rangefinding study and Task Four is the chronic and reproductive toxicity study. The NCTR will develop the protocols and Standard Operating Procedures and set up the project. They will subcontract the animal care and feeding, housing, routine weights and clinical observations, food consumption, breeding and collection of routine animal samples during the study (microbiological surveillance, vaginal lavage, etc.) pending identification of appropriate subcontractors for support functions. The subcontracted mink husbandry will be located in a mink-ranching region, e.g., Wisconsin or Minnesota. They will handle the collection of tissues and the sperm motility evaluations on sacrifice days. The specimens will be returned to NCTR for processing and analysis. Preparation of the diet, to include incorporation of the DIMP, will be handled by a subcontractor to be determined.

PROGRESS: Tasks 1 and 2 are in progress. The draft protocol for the dose range finding study, is in preparation. The protocols for the chronic study and the reproductive toxicity study have been completed and are presently being reviewed by the National Academy of Sciences Committee on Toxicology.

OCCUPATIONAL HEALTH RESEARCH BRANCH

Occupational health research FY90 made significant progress towards the research goal of protecting soldier health. Occupational health research has three distinct areas of emphasis that include exposure assessment, health effects, and field water and sanitation. Continued efforts to further growth in these areas will produce greater dividends in refining health risk assessment, understanding health effects, and preventing or reducing the disease/injury risk to the soldiers.

Exposure Assessment. An important aspect of the occupational health exposure assessment research has been to refine sampling capabilities for a variety of airborne substances such as carbon monoxide (CO), hydrogen chloride (HCl), and respirable aerosols and particulates. Exposure assessment research is also aimed at evaluating the extent of soldiers' exposure to smoke and airborne weapons combustion products under actual field conditions and requires sampling in the field during equipment testing and field training exercises. Opportunities for field sampling have been scarce in the past due to the lack of understanding and willingness of field units to cooperate. To some extent, such attitudes of the field units have begun to improve. Initial work has begun in conducting exposure assessment research into particle-size distribution and associated mass concentrations of pollutants in order to understand health effects, particularly when a principal route of exposure is through inhalation. Complementing industrial hygiene sampling with biological or metabolite monitoring, to the extent possible, follows the current trend in the total evaluation of personnel exposure and is considered whenever feasible. The branch continues to pursue opportunities to identify research needs and to provide research support to weapons and materiel development throughout the acquisition decision processes. The benefits achieved are through addressing associated health concerns and the realization of tangible savings that would otherwise become costs due to retrofits.

In refining sampling capabilities for CO, HCl, and respirable substances, research has been concentrated on development of instrument capabilities in terms of the sensitivity, precision, specificity, and interference in contaminant detection and how adaptable the instrument can be for military training and testing environments. Innovative techniques of field measurements continue to be evaluated, and new laboratory capabilities are developed. The reliability of field sampling data has thus been significantly improved.

Major field study efforts were completed by the Branch in evaluating soldier exposures to smokes and weapons combustion products. A major field study was completed by this Laboratory on the study of artillerymen exposure to lead in weapons emissions of the 155MM howitzer. A follow-on effort to evaluate artillerymen and control soldiers with 5, 10, and 15 years of service to determine cumulative lead exposure effects was initiated. In order to support health effects research, a ballistic combustion chamber is now fully operational for characterizing combustion products from both the breech and

muzzle of an M-16 rifle. Studies have begun to identify and quantitate polynuclear aromatic hydrocarbons and to evaluate the overall carcinogenicity of the particulate material from the weapon.

Toxic Health Effects. The lack of clear-cut military-unique exposure standards has limited the utility of field exposure assessment and makes it difficult to determine an acceptably safe level in an exposure scenario or to educate field soldiers about exposure hazards. Toxicological investigation and review allow a methodological approach to understanding risk potentials and toxic health effects and provides a basis for the development of military-unique exposure standards for those substances of concern to military operations.

A military-unique exposure standard for fog oil has been recommended and is currently under review. Further efforts will continue to develop recommended military-unique exposure standards for other airborne smoke materials. A long-running study of the health hazard of munitions contaminated dimethylsulfoxide was recently completed. These mixtures consistently produced highly mutagenic results in assays, despite the fact that none of the individual compounds were positive. The project has been terminated by the Department of the Army due to budgetary considerations. Research experiments have revealed the unexpected toxicity of a mixture of dyes for smoke ingredients, and a recommendation to terminate the use of such dyes was provided. A new smoke formulation, designated C28 and consisting of ammonium perchlorate, ammonium chloride, and carboxy-terminated polybutadiene, has been tested in the laboratory using miniature smoke canisters, revealing HCl in abundance under test environments. Polynuclear aromatic hydrocarbons also were produced by the C28 miniature smoke canisters.

Another aspect of the health effects research is the review of career exposure and demographics studies on the military occupational specialty 54B personnel (Smoke Generator Operator). The approach for these studies is to be used as a model for future demographic efforts in other military occupational specialties.

Field Water and Sanitation Research. Occupational health research on field water is intended to identify disease risk potentials associated with field water supply and soldier sanitation practices. Research emphasis is being placed on the identification and evaluation of microbiological hazards and their impact on soldiers, rapid detection procedures, and disinfection efficiency of both water treatment processes and disinfectants, and as a result, on the development of water quality standards for military use. Common sense and simple, yet often ignored, field sanitation practices are critical to conserving the fighting strength. In this area, research activities in the Branch are concerned with showering/washing effectiveness against dermal and related diseases.

In-house studies have determined the effectiveness of "Chlor-Floc" and chlorine dioxide disinfectants for enteric bacteria, viruses, and protozoan cysts. Viruses and bacteria are readily disinfected by these disinfectants at

recommended use levels; however, neither was effective for protozoan cysts (nor were iodine tablets). Studies on the molecular effects of chlorine dioxide disinfection of polio virus indicated that both protein and ribonucleic acid (RNA) were equally affected after very short disinfection time periods, thus suggesting that viruses may not have a preferential target for this disinfectant. Other studies evaluated the British "Pre Mac" individual soldier water purifiers for removal of the three classes of waterborne microorganisms. The "Pre Mac" unit was able to satisfy U.S. Environmental Protection Agency microbial removal requirements.

Studies to establish the best "off-the-shelf" microbiological test kit capabilities for field use determined that the Colilert test kit (in membrane filter and presence/absence mode) should be used to replace the current total coliform test. Also, the incorporation of a bacteriophage (coliphage) test with a 4- to 6-hour test time was recommended. Long-range development to enhance the preventive medicine test kit centered around the use of deoxyribonucleic acid/ribonucleic acid probes with amplification of hybrid probe and detection with laser spectrometry. Additional studies are evaluating enzyme and antibody electrodes to detect coliform organisms using electrochemical (conductance or resistivity) detection in actual water samples.

The development of new water quality standards for indigenous/ anthropogenic chemicals, waterborne microorganisms, and NBC agents has proceeded to the point where the tri-services have accepted the nonagent standards and are in the process of reviewing agent standard recommendations for field water supplies. Several off-the-shelf water test kits for arsenic, cyanide, and magnesium were evaluated and recommended to be included in the preventive medicine test kits which were upgraded in support of Operation Desert Shield.

The efficacy of various media to remove microbiological agents and biotoxins is important. Currently, results suggest that the Army's reverse osmosis water purification unit (ROWPU) is an effective barrier to biotoxins over a wide range of chemical structures, but technologies based on flocculation/coagulation, such as the ERDLator, or on disinfection by hypochlorite (HTH) or iodine (Globaline) provide little or no protection.

Studies in Support of Chemical Agent Demilitarization. Since the Army Secretariat decided to cancel the chemical agent toxicology program, most program efforts have been directed towards termination of existing contracts. Two extensive toxicology contracts at Battelle Pacific Northwest and at the University of California, Davis, have been completed. The remaining work at the National Center for Toxicological Research, Jefferson, AR, is mostly limited to data analysis and report writing. An extensive review on the vesicant agent Lewisite was completed and subsequently published in the journal, "Reviews of Environmental Contamination and Toxicology." Two further review papers dealing with sulfur mustard and inorganic arsenic compounds have been prepared and are undergoing final editing reviews prior to submission for publication.

THIS PAGE INTENTIONALLY LEFT BLANK.

INFORMATION PAPERS FOR PROJECTS ACTIVE IN FY90
OCCUPATIONAL HEALTH RESEARCH BRANCH

THIS PAGE INTENTIONALLY LEFT BLANK.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0001 28 September 1990

TITLE: Biomedical Assessment of Toxic Effects of Chemical Agents

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F375 CONTRACT: WORK UNIT: 229

RAD: V TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMBRDL, SGRD-UBG-M, 15 Dec 83, subject: Health Effects Research in Medical Defense Against Chemical Agents, with 1st End, USAMRDC, SGRD-PLE, 23 Feb 84

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Dacre, Jack C. COR:

OBJECTIVES: The study will review and evaluate the published and other available literature on the chemical agents Lewisite and sulfur mustard. This information, together with the results of ongoing mammalian toxicological studies, will be used to establish data bases for the derivation of occupational health criteria for Department of the Army workers and military personnel.

APPROACH: This study will involve the collection of reports, journal and review publications, published books and monographs, as well as proceedings and abstracts of meetings, symposia, and workshops on both Lewisite and sulfur mustard. This involves the extensive searching of all appropriate literature data bases, as well as searching the records at the U.S. Army Chemical Research, Development and Engineering for unpublished, Confidential and Secret reports.

PROGRESS: The review paper of Lewisite has been published in the journal, "Review of Environmental Contamination and Toxicology," Volume 110 (1989), pages 75-115. The paper titled "Pharmacology and Toxicology of the Warfare Agent Sulfur Mustard" is undergoing a final review prior to submission for journal publication. Material from the original Lewisite report has been reassembled under the title "Inorganic Arsenic Compounds: Are They Carcinogenic, Mutagenic, Teratogenic?" This paper also is undergoing final review prior to submission for journal publication. The Technical Report Number 8816, "Recommended Field Drinking Water Criteria for Chemical Agent Sulfur Mustard," has been completed and published under AD A221745.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0002 28 September 1990

TITLE: Development of a Real-time Hydrogen Chloride (HCl) Monitor

PROPONENT COMMAND(S): U.S. Army Medical Research And Development Command

APC: F964 CONTRACT: WORK UNIT: 246

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Hoke, Steven H. COR:

OBJECTIVES: A technique for real-time measurement is to be developed of all forms of HCl generated by weapons which use perchlorate-based rocket fuel.

APPROACH: A rapid technique will be developed to trap HCl gas, HCl adsorbed on particulate matter, and HCl aerosols using miniature impinger and flow injection analysis techniques. The trapped impinger solution will be continuously sampled and pumped through a flow cell containing a chloride ion-selective electrode. The electrical potential from the electrode will indicate the HCl concentration in the atmosphere.

PROGRESS: A prototype HCl monitor which uses pressurized gas to drive standards and trapping solution instead of a peristaltic pump has been designed and built by a local contractor. This system was delivered in second quarter FY90. It performed well in the laboratory and under field conditions. By making some modifications to this monitor, we have demonstrated that it can perform as an atmospheric hydrogen fluoride monitor as well. A flow-through fluoride electrode similar to the chloride electrode is under development which should be more economical and provide for faster response times. A solicitation has been initiated for a contractor to build five more copies of the HCl monitor and two copies of an HF monitor. A safety protocol for working with high levels of HF in the laboratory has been developed and is currently being reviewed. A complete evaluation of the monitor's response to HCl gas, HCl aerosols, and HCl adsorbed onto particulate matter is underway.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0003 28 September 1990

TITLE: Evaluation of Breathing-zone Exposure to Prototype Advanced Antitank Weapon System - Medium (AAWS-M) Exhaust

PROPONENT COMMAND(S): U.S. Army Missile Command

APC: F995 CONTRACT: WORK UNIT: 248

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: REIMB

REQUIREMENTS DOCUMENT: Letter, USAMICOM, AMCPM-AM-E, 24 Oct 86, subject: Medical/Bioengineering Support to AAWS-M, with 1st End, USAMRDC, SGRD-PLC, 8 Dec 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Young, John Y. COR:

OBJECTIVES: The project will develop procurement specifications for allowable exposure concentration limits to airborne combustion products in missile exhaust from the firing of the prototype AAWS-M for the U.S. Army Missile Command (USAMICOM).

APPROACH: The USAMICOM will provide the Laboratory the AAWS-M development schedule and the proposed propellant for the weapon. The Laboratory will provide medical research support to evaluate health hazards associated with the combustion products emitted from the use of the proposed propellant. This includes developing criteria to sample specific airborne combustion products emitted from the AAWS-M prototype test firing in both unmanned and manned launch conditions. Sampling results will be the basis for AAWS-M procurement specifications relating to personnel exposure concentration limits of combustion products in the final design of the weapon system.

PROGRESS: USABRDL continued to provide health-related input to USAMICOM for the AAWS-M design and acquisition program. While preparations were made to begin air sampling for the Development Proveout Phase (slug test), the contractor needed to redesign a portion of the launch system to improve the performance. Hence, schedules for the slug test have been delayed until Nov 90. Preparations for air sampling continue to respond to changing schedule of the slug test. In the meantime, USABRDL has completed a full scale air sampling at USAMICOM's request, to evaluate combustion products from the Antitank Weapons Effect Signature Simulator training device and has subsequently provided recommendations pertaining to the use of such device.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0004 28 September 1990

TITLE: Measurement of Carbon Monoxide (CO) Using an Alveolar Breath Technique

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F951 CONTRACT: WORK UNIT: 249

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 7 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-OSO), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: In-house

PI: Allen, Joseph T. CCR:

OBJECTIVES: A field expedient noninvasive method for measuring body burden of CO will be developed.

APPROACH: Review all relevant literature. Familiarize with methods and improve them if possible. Refine and standardize the methods with input from other agencies.

PROGRESS: A rapid method is needed for determining blood carboxyhemoglobin (COHb) in military field environments. The most common method available to determine COHb utilizes a laboratory analytical procedure. Although this technique is accurate, it is time-consuming and offers none of the flexibility desired for field environment. After a review of literature, a technique using the concentration of CO in expired alveolar air to indicate blood COHb was identified. Commercial equipment is available to collect alveolar air samples and determine its CO concentration. By use of a curve to correlate alveolar CO and blood COHb, the needed data can be obtained in a matter of minutes. This report describes light-weight equipment and easy procedures suited to a military field setting. The equipment, in a briefcase-sized container, is commercially available to initiate field testing.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0006 28 September 1990

TITLE: Problem Definition Study for Developing Military Unique Criteria for Toxicants

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F990 CONTRACT NO.: WORK UNIT: 255

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Palmer, Winifred G. COR:

OBJECTIVES: The objective is to perform a problem definition study for the purpose of identifying the scientific issues which must be addressed in developing military-unique criteria. The study will have two phases: Phase I will examine military-unique, continuous, low-level exposure settings, and Phase II will examine military-unique, short-term, high-level exposure settings.

APPROACH: The study will involve the collection of reports, journal and review publications, published books and monographs, and proceedings and abstracts of meetings, symposia, and workshops. This will initially involve searching all the appropriate data bases with special emphasis being given to work conducted/related to occupational health problems, in support of Army-related activities. The data will be evaluated and summarized, the data gaps will be identified, and recommendations will be made for the development/derivation of the identified specific military-unique occupational health criteria. Where sufficient data exist, recommendations for criteria setting procedures will be developed. The current methodologies developed by other Federal agencies for deriving occupational exposure criteria will be reviewed especially for their applicability to military-unique conditions. These organizations include the Occupational Safety and Health Administration, the U.S. Environmental Protection Agency, and the American Conference of Governmental Industrial Hygienists.

PROGRESS: Literature searches have been completed and updated. Most relevant documents have been obtained and are being reviewed.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0007 28 September 1990

TITLE: Laser Spectrometer for Rapid Toxicity Screening and Detection of Waterborne Microorganisms and Chemicals

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F416 CONTRACT: WORK UNIT: 262

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 8 Dec 86, subject: Guidance for Medical Research to Ensure Potability and Palatability of Combat Water Supplies

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Schaub, Stephen A. COR:

OBJECTIVES: The objective of the study is to verify the effectiveness of laser spectrometry in conjunction with bacterial bioassay test strains to rapidly screen field drinking water for toxic chemicals and to establish microbiological bioassay dose response data for the toxicants. Secondly, the study will determine if the spectrometer can rapidly detect antibody-antigen interactions specific to pathogens and chemical toxicants, and determine its use with deoxyribonucleic acid (DNA) probes for detecting pathogens in water.

APPROACH: Specific wild type and isogenic mutant strains of Bacillus subtilis bacteria will be evaluated as bioassay organisms to determine their growth and morphological responses over a short (<90-minute) time period to an array of toxic chemicals likely to be found in combat drinking waters. The organisms will be challenged over a 3-order of magnitude chemical concentration range to determine their dose responses with the laser spectrometer. Also, the study will examine the laser spectrometer's use in rapidly determining if DNA probes can be used to identify specific biological organisms. The spectrometer will also be evaluated for its ability to detect specific interactions of antibody-antigen complexes such as agglutination and precipitation reactions.

PROGRESS: Studies have been conducted to establish the correlation of morphologic changes by bacterial test strains in response to toxic chemicals in water as detected by laser spectrometry. Scanning and transmission electron microscope pictures have been prepared for direct correlation of size and shape of bacteria to laser scan profiles. Work has been conducted to develop dose response information on waterborne chemicals of concern with the toxicant bioassay system. Further data development on the detection of biological toxins at the National Institute of Science and Technology is anticipated as a cooperative effort. Separate efforts demonstrated that the laser spectrometer can detect DNA hybridization as used in nucleic acid probes.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0008 28 September 1990

TITLE: Risk Assessment Model for Liquid Gun Propellant (LGP)

PROPONENT COMMAND(S): U.S. Army Laboratory Command

APC: F967 CONTRACT: WORK UNIT: 254

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, U.S. Army Ballistic Research Laboratory, AMXBR-IBD, 27 Mar 85, subject: Review of HAN-Based Liquid Propellants, with 3d End, HQDA (DASG-PSP-E), 14 May 85

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Parmer, David L. COR:

OBJECTIVE: The purpose of the study is to develop a mathematical model for use in assessing health risks inherent in transportation, transfer, storage, and use of LGP.

APPROACH: Following review of models for assessing occupational exposures to chemicals, one has been selected to be applied to LGP. Input for the model will be derived from an analysis of critical control points in the proposed use scenario and a review of accident data for similar liquid transfer operations. A table of expected health effects in man will be extrapolated from animal exposure data. The final product will be a quantification of risk based on an estimate of the probability of an event, the potential for a resulting exposure, and the likelihood of a health effect as an outcome.

PROGRESS: Experimental results from an Air Force Study on a nitrate containing liquid propellant were received and are under review. In the study methemoglobinemia resulted from dermal exposure and recovery times were recorded. Future Air Force work will examine the pharmacokinetics of skin penetration. Further progress in modeling risks is dependent upon the development of use scenarios, along with estimates of failure modes. A contract to develop this information was given by the Ballistics Research Laboratory to the Jet Propulsion Laboratory (JPL). JPL produced a preliminary report in March, 1989, but has yet to produce information of use to the modeling effort. By the end of the 1Qtr, FY91, sufficient information is expected from the swine dermal work to develop that portion of the model dealing with effects.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0010 28 September 1990

TITLE: Evaluation of Ventilation Inside Armored Vehicles

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F968 CONTRACT: WORK UNIT: 254

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Needs, with 1st End, OTSG, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: In-house

PI: Terra, Joseph A. COR:

OBJECTIVE: The objective of this research project is to establish medically based criteria for ventilation in military armored vehicles to allow for both a hazard-free breathing environment and an adequate evacuation system for combustion by products and weapons exhaust.

APPROACH: The approach of this project is to acquire specifications for supplied air and general area ventilation from the U.S. Air Force, U.S. Army, NIOSH and OSHA. Literature pertaining to ventilation in military armored vehicles or aircraft will be reviewed. An experimental design will be applied to define contaminant dispersion and ventilation effectiveness in armored military vehicles. Also, ventilation modeling algorithms for confined spaces will be applied to military armored vehicles for simulating exposure environments during various modes of operation and means of ventilation. If necessary, recommendations will be made for updating ventilation requirements in armored vehicles.

PROGRESS: A literature search was conducted under DTIC request number 04027M, dated 17 Aug 89, for the technical report database and request number 04033I, dated 17 Aug 89, for the work unit data base. The proposed effort will not result in a duplication of effort. Information gathering visits were conducted at Aberdeen Proving Ground, MD. The M1A1, M-2, and M60 vehicles were examined during the visits to determine the extent and capabilities of the present ventilation systems. Previously documented ventilation test data was also collected. A draft copy of the technical report entitled "Evaluation of ventilation inside armored vehicles" has been written. Data in the report includes theoretical and actual ventilatory rates for the M1A1, M60, and M-2, as well as projected combustion product concentrations during the several differing modes of ventilation capable by the individual vehicles.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0011 28 September 1990

TITLE: Exposure Assessment to Smoke and Weapons Combustion Products

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F969 CONTRACT: WORK UNIT: 242

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Young, John Y. COR:

OBJECTIVES: The objective of the study is to determine the extent of soldiers' exposure to smoke/obscurants, carbon monoxide (CO), oxides of nitrogen, and other constituents in weapons firing during training.

APPROACH: Industrial hygiene samples are to be collected during actual training to assess the extent of soldiers' exposure to various chemical contaminants. Three major subtasks include field studies on soldiers' exposures to smoke during training at Fort McClellan and in combat training exercises in U.S. Army Forces Command installations; development of a research master plan for smoke exposure research; and development of a sampling strategy for evaluating CO and other key pollutants in aircraft.

PROGRESS: During FY90, exposure assessment research at USABRDL included a field sampling to evaluate soldiers' exposure to hexachloroethane smoke during an engineer unit bridge crossing training exercise at Fort Bragg, and a particle-size selective sampling study at Dugway Proving Ground to characterize the mass concentration and particle size distribution of an experimental fibrous smoke. The fibrous smoke study had not produced any meaningful result, and further sampling is being scheduled for Nov 90. USABRDL continues to coordinate with field units for opportunities to conduct field sampling in different smoke training scenarios. Arrangements have been made with a chemical unit at Fort Ord to conduct field sampling on mobile smoke sources using fog oil. The study was scheduled for Sep 90, but was subsequently delayed until further notice.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0012 28 September 1990

TITLE: Pollutant Exposure Demographics

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F970 CONTRACT: WORK UNIT: 250

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Allen, Joseph T. COR:

OBJECTIVES: The project will develop medical demographic information for assessing soldier exposure to pollutants, focusing on smokes/weapons combustion products within the target military occupational specialities (MOS): 11M, 13B, 19D, 19E, 19K, and 54B.

APPROACH: Conduct a comprehensive review of the subject throughout military and civilian sources. A model or guide will be developed to identify types of information needed. Data will be gathered from sources, i.e., units, personnel centers, training schools. This information will be combined into a picture of soldier exposure to work-related pollutants.

PROGRESS: The demographics model progressed from the outline phase to near completion. A data gathering trip was taken to Fort Hood, TX where the personnel files for all soldiers on Fort Hood having the MOS 54B chemical operations specialist were screened to procure assignment information. Of particular concern was each soldiers combined total of years spent in active fog oil smoke generating units. There are 20 of these units in the U.S. Army that provide fog oil covering smoke during military operations. The personnel in these units are exposed to fog oil smoke during several job tasks to include: maintenance of fog oil generating equipment, observation of equipment placement and smoke cover, and actual operation of the fog oil generators. This information was combined with the results obtained from a questionnaire that was used to determine the amount of time soldiers in each rank spend in a fog oil smoke environment during their duty hours. After statistical analyses were completed on all the raw data, the demographics model was developed further. Presently, data (age, race, gender) received from the U.S. Army Military Personnel Center on MOS 54B personnel are being combined with potential exposure information on assignment to smoke generating units at Fort Hood, TX. A final detailed outline demographics profile has been completed, and preparation of a final report is underway.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0013 28 September 1990

TITLE: Characterization of Propellant Combustion Products

PROPONENT COMMAND(S): U.S. Army Medical Research And Development Command

APC: F971 CONTRACT: WORK UNIT: 247

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Hoke, Steven H. COR:

OBJECTIVES: The study will determine the propellant combustion products from the firing of small caliber weapons and will determine how these products vary with size of the charge and propellant formulation.

APPROACH: An M16 firing chamber will be used to collect gas and particulate combustion products from an M16 rifle. Sampling procedures and analytical methods will be developed to analyze these combustion products. An attempt will be made to identify and quantitate as many of the major and minor combustion products as possible.

PROGRESS: Combustion product evaluation studies on the M16 rifle got underway this fiscal year. Firing the weapon and collection of samples is now a routine operation. Both breech and muzzle samples have been collected and analyzed for polycyclic aromatic hydrocarbons and various metals. Particulate samples also have been collected for carcinogenicity studies. The teflon divider used to separate the breech and muzzle gases has developed several small holes presumably caused from bullet fragments generated when the bullet hits the impact plug. This Laboratory is currently designing a more sturdy divider. The impact plugs tend to erode too rapidly if they are too soft; and if they are too hard, the whole plug can shatter. The heat treatment process is being perfected, this Laboratory is considering alternative methods for stopping the bullet. Two possibilities are firing into a tank of water or possibly firing directly into the ground through the basement wall. Any changes in the current procedure will be approved by ballistics personnel at Aberdeen Proving Ground, MD. A consultant contract has been established to conduct thermodynamic modeling of the combustion products from the M16 rifle.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0014 28 September 1990

TITLE: Review of Short-term High-level Exposure to Select Metals

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F972 CONTRACT: WORK UNIT: 259

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Eaton, James C. COR:

OBJECTIVES: The study will review the exposures of military crewmen to selected metals which are produced in weapons firing, and determine the potential for adverse health effects or performance decrement from those exposures.

APPROACH: Search the literature on physiologic effects from exposure to airborne aluminum, antimony, barium, cadmium, copper, lead, and zinc. Review the data base on chemical composition, concentration, physical form, and temporal and spatial distribution of weapons system exhaust. Critically review the health effects data base for relevance to military exposures, considering the physical and chemical parameters and their relationship to health effects, the contributions of exposure duration and concentration to physiological effects, effects of particle size distribution upon systemic and target organ dose, and interactions among the metals.

PROGRESS: The model used to predict blood lead concentration after exposure to airborne lead consistently over-predicted the responses of artillery crewmen who were exposed during a series of 96-hour tests of old and new versions of the howitzer. Tin was added to the list of metals in the study because of interest in it as a replacement for lead as a de-coppering agent in artillery weapons. A review of the toxicities of tin, gallium, and bismuth as candidate replacements for lead resulted in the recommendation that the research should concentrate on tin because of its lack of toxicity and the far greater potential for adverse health effects among soldiers exposed to gallium or bismuth. All of the necessary information on aluminum, antimony, barium, cadmium, copper, lead, tin, and zinc has been assembled and reviewed; and the writing of the review of the exposure to the metals and the health implications has begun. The final report for this project is in preparation.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0015 28 September 1990

TITLE: Evaluation of Cryptosporidium Removal Through Bypass of Reverse Osmosis Elements on Army Reverse Osmosis Purification Unit (ROWPU)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F954 CONTRACT: WORK UNIT: 257

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 8 Dec 86, subject: Guidance for Medical Research to Ensure Potability and Palatability of Combat Water Supplies

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Schaub, Stephen A. COR:

OBJECTIVES: The project will determine the treatment effectiveness of Army water treatment equipment unit processes for the removal of Cryptosporidium oocysts from fresh water.

APPROACH: Bench model filtration units, representing pre-reverse osmosis (RO) filter components, Erdlators, and individual water treatment units, will be challenged with Cryptosporidium parvum oocysts and appropriate cyst simulants (2-5 micron particles) to determine the effectiveness of the filters and procedures for purifying typical field waters. If existing equipment and procedures are not adequate for cyst removal, then alternative filters and media or modes of use are to be examined for potential replacements or adjuncts for current equipment.

PROGRESS: Draft final report of Katadyn pocket purifiers was prepared for review. Studies are underway to evaluate the British "Pre-Mac" individual water purifiers according the the U.S. Environmental Protection Agency's Guide Standard and Protocol for Testing Microbiological Water Purifiers. The Navy Civil Engineering Laboratory continues to have interest in our evaluation of the microbiological removal by the Marine Corps diatomaceous earth filtration unit if reimbursable funds become available. Similarly, both the Air Force and Marine Corps are interested in the evaluation of the fresh water bypass for ROWPU if money becomes available. The Air Force Surgeon General needs to approve the test protocol before we could initiate testing. A ground site at the Fort Detrick wastewater treatment plant has been evaluated as a test site for both of the above studies.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0016 28 September 1990

TITLE: Comparative Evaluation of Field Water Treatment Technologies for Reuse of Field Shower Water

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F951 CONTRACT: WORK UNIT: 256

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 8 Dec 86, subject: Guidance for Medical Research and Development to Ensure Potability and Palatability of Army Combat Waters

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Burrows, W. Dickinson COR:

OBJECTIVES: The project will evaluate low-pressure membrane, reverse osmosis and ERDlator technologies in terms of their abilities to meet health concerns identified by the National Research Council for recycle of Army shower water.

APPROACH: Tests will be conducted using the Memtec microfilter in both batch and continuous modes. Removal of total organic carbon (TOC) from synthetic shower water will be monitored, and the effects of variations in operational parameters will be examined. Samples of authentic shower waters will be collected at field exercises in order to: (a) compare critical parameters with those of synthetic shower waters, (b) identify microbiological contaminants, (c) assess shower water treatment methods, and (d) identify potentially hazardous chemical components of shower waters, in particular, chlorinated compounds formed from soap or other materials in the course of disinfection.

PROGRESS: Laboratory microfiltration studies consistently show 70 to 80 percent removal of TOC from synthetic shower water. However, the limited lifetime of filter elements and low product water flux may make this system impractical for field use. Treatment of authentic shower waters from military personnel engaged in field exercises, by means of a bench scale ERDlator, achieved 60 to 80 percent TOC removal. No microorganisms or nonvolatile organic compounds have been found in authentic field shower waters dosed with 5 mg/liter of free available chlorine. A technical report, "Shower Water Recycle I. Raw Shower Water Characteristics and Treatment," has been published; and two others, "Shower Water Reuse II. Health Effects" and "Shower Water III. Microfiltration Studies," are in review.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0017 28 September 1990

TITLE: Optimum Disinfectant Properties and Commercially Available Disinfectants

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F951 CONTRACT: WORK UNIT: 258

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 8 Dec 86, subject: Guidance for Medical Research and Development to Ensure Potability and Palatability of Army Combat Waters

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Burrows, W. Dickinson COR:

OBJECTIVES: This project will identify alternative drinking water disinfectants for military field use that will improve overall disinfection performance.

APPROACH: Deficiencies of the current disinfectants will be listed, and criteria for an ideal water disinfectant and a rating matrix will be developed and staffed. The criteria will take into account factors such as toxicity, residual taste and odor, storage characteristics, reaction kinetics, effectiveness over a broad range of conditions, and method of application. A product and literature survey of off-the-shelf and developmental disinfectants will be conducted to identify promising disinfecting agents. The performance of these agents will be evaluated relative to the performance of the current disinfectants.

PROGRESS: Disinfection deficiencies, ideal water disinfection criteria and a rating matrix have been developed and staffed throughout the Department of Defense. Product and literature surveys are complete. Two products, Chlor-Floc and chlorine dioxide, have been identified for evaluation of efficacy, to be performed in-house; and others are being considered. Health and efficacy criteria for drinking water disinfectants in general have been pursued through contacts with government agencies and professional organizations. A technical report, "Optimum Disinfection Properties and Commercially Available Disinfectants," has been published. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0018 28 September 1990

TITLE: Microbiological Assessment of Alternative Disinfectants for Field Drinking Water

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F980 CONTRACT: WORK UNIT: 264

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878

REQUIREMENTS DOCUMENT: Letter, USABRDL, SGRD-UBG-O, 2 Dec 88, subject: Field Water Medical Research Requirements, with 1st End, USAMRDC, SGRD-PLC, 24 Jan 89

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Schaub, Stephen A. COR:

OBJECTIVES: The study will evaluate the disinfection effectiveness of ClO_2, "Chlor-Floc," and other disinfectants under Army field use conditions for typical waterborne bacteria, viruses, and protozoa. Disinfectant residuals, half-life, and ClO_2 preparation in the field will also be examined.

APPROACH: The ClO_2, "Chlor-Floc" and other new disinfectants will be evaluated according to the manufacturer's instructions. Kinetic disinfection studies will be performed using test bacteria (Klebsiella terrigena); virus (ECHO virus 1) and protozoa (Cryptosporidium parvum) within a range of standard test water conditions provided by the U.S. Environmental Protection Agency. The concentration/time for disinfection will be established for appropriate disinfection at each condition. Field training exercises will evaluate the effectiveness of maintenance of a 1 mg/L free chlorine residual in water from various Army water storage and distribution equipment.

PROGRESS: The evaluation of "Chlor-Floc" on bacteria, virus and protozoan cysts has been completed. Virus and bacteria are readily disinfected under all test conditions even without filtration. Protozoan cyst removals were determined to be inadequate by coagulation/flocculation and filtration. Animal infectivity studies of the disinfected, flocculated material showed less than one order magnitude cyst disinfection. Comparative data indicate that "Chlor-Floc" represents some improvements over iodine tablets. Chlorine dioxide field packets provided disinfection of viruses and bacteria meeting removal requirements at all pH's and water conditions tested. Protozoan cyst removals by disinfection were less than 1 order of magnitude and did not meet criteria (3 micron filtration would be required), however pH limitations on disinfection were not noted to be a factor compared to the other disinfectants.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0019 28 September 1990

TITLE: Rapid Field Microbiology Test Kit

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F983 CONTRACT: WORK UNIT: 243

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENTATION: Letter, HSHA-CMD, 16 Dec 88, subject: Draft Operational and Organizational Plan (O&O) for a Family of Medical Water Quality Monitoring Equipment (FMWQME)

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Schaub, Stephen A. COR:

OBJECTIVES: The objective is to develop a rapid field water microbiology test kit which will determine water quality in near real-time. The test kit will be developed to quantitatively measure bacterial indicator organisms and other indicators of microbiological pollution in field drinking waters. The kit will have the capability to specifically measure selected pathogens other than fecal bacteria. The kit will be developed to fit within the guidelines of the O&O plan titled "A Family of Equipment to Monitor Health Related Water Quality."

APPROACH: A survey of new microbiological detection technologies will be performed to determine which are most ammenable to adoption to Army field drinking water requirements. Those best meeting military operational requirements will be used as the basis for developing specific capabilities to detect coliform bacteria at required detection levels to ensure satisfactory determination of microbiological water quality. The technologies will be evaluated against water qualities representative of those likely to be found in fresh waters around the world.

PROGRESS: A literature review and market survey of available and developmental techniques for the rapid determination of microbiological water quality under field conditions has been completed. Both near term and long range development recommendations have been established. For the near term, based upon our research, it is recommended that the Colilert membrane filter and presence/absence techniques be used as a replacement for the current total coliform techniques because they can utilize current kit equipment and configurations and can provide enhanced information on the presence of Escherichia coli. Also recommend inclusion of a coliphage assay system to reduce time to indicate fecal pollution to 4-6 hours. Long-range development plans focus on the use of gene probes and methods of amplifying the DNA hybrids so that the test can provide specific information on any waterborne microorganism in 1 hour. Laser spectrometry will also be evaluated as the mechanism for probe detection.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0021 28 September 1990

TITLE: Preliminary Health Hazard Assessment for Candidate Smoke Materials

PROPONENT COMMAND(S): U.S. Army Materiel Command

APC: F962 CONTRACT: WORK UNIT: 268

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Eaton, James C. COR:

OBJECTIVES: The smoke produced by a new fill, identified as C28, consisting of ammonium perchlorate, ammonium chloride, and carboxy-terminated polybutadiene that is proposed for use in the M8 grenade will be characterized; and health hazard implications will be analyzed.

APPROACH: Smoke will be produced first in small amounts under laboratory conditions in order to develop analytical techniques and to provide a first approximation of the composition of the C28 smoke. The full-scale experiment will involve functioning of a full-scale M8 grenade in a tent enclosure and analyzing the aerosol and vapors produced for toxic components, particularly mineral acids and organic compounds. Preliminary assessment of health hazards will be based upon the toxicity data base for the identified components of the smoke.

PROGRESS: Aluminum canisters filled with 10 grams of the C28 material were functioned in a glove box, and the smoke produced was sampled on filters and adsorbent tubes and in impingers and analyzed for organic and inorganic components. Carbon monoxide and hydrogen chloride were measured using continuous monitors, and particle-size distribution was determined using cascade impactors. The smoke consisted of ammonium chloride with sufficient hydrogen chloride to make it an irritant to skin, eyes, and the respiratory tract. Poly-nuclear aromatic hydrocarbons also were produced in quantities analogous to the output of a home wood stove. Experiments with full-size grenades will be performed when these are available.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0023 28 September 1990

TITLE: Treatment of Water by Reverse Osmosis for Removal of Organic Chemicals

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F981 CONTRACT: WORK UNIT: 294

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Memorandum, USABRDL, SGRD-UBG-O, 2 Feb 88, subject: Field Water Medical Research and Development Requirements, with 1st End, AHS, USA, HSHA-CDS, 19 Apr 88

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Burrows, W. Dickinson COR:

OBJECTIVES: Reverse osmosis (RO) will be assessed for treatment of water containing organic chemicals, to include chemical agents, chemical products of biological agents, opportunity poisons, and environmental products therefrom.

APPROACH: A literature study will be conducted to evaluate present knowledge concerning the use of RO for removal of trace organic chemicals from water. Reverse osmosis will be modeled in the laboratory using a single-cartridge RO test stand. Initial studies will be carried out with organic chemicals judged to be opportunity poisons; these will include fluoroacetate, hydrazine, phenol, diesel fuel, chloroform, ethylene glycol, and a pesticide. Parallel and follow-on studies will include hydrolysis products of nerve agents, vesicants, and agents of biological origin, as well as other candidates suggested as a result of the literature survey.

PROGRESS: The literature study (A.P. Sincero: "Reverse Osmosis Removal of Organic Compounds - A Preliminary Literature Review") has been prepared. The RO test stand is in operation. Rejection has been determined for the salts of fluoroacetic acid, bromoacetic acid, chloroacetic acid, and isopropyl methylsulfonic acid and has been found to exceed 98 percent under most conditions.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0024 28 September 1990

TITLE: Biological Responses to Lead in 155MM Howitzer Crewmen

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F951 CONTRACT: WORK UNIT: 260

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878 REIMB

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Weyandt, Timothy B. COR:

OBJECTIVES: This study will develop information on biological responses to soldiers exposed to weapons aerosol lead. A new protocol was added in July 1990 with the objective of identifying potential adverse relationships between blood lead, total bone lead, zinc protoporphyrin, complete blood count and male reproductive capacity in 155MM crewmen as a function of length of employment.

APPROACH: Air lead data will be correlated with blood lead data and with nerve conduction velocity data collected during the operational test. The new protocol will be piggy-backed onto an evaluation of effects of cumulative lead exposures in 155MM crewmen with differing exposure durations (contract with Argonne National Laboratory). A zinc protoporphyrin, complete blood count, limited endocrine evaluation, and careful semen analysis will be performed. Comparison between the duration of exposure and adverse male reproductive effect will be collected and analyzed.

PROGRESS: The final report on air exposure during the operational test is being written. The new protocol was performed at Fort Hood, TX between 2-27 Jul 90. Male participants were solicited from 24 military units; 202 signed informed consent forms, 88 partially fulfilled study parameters, and 83 participants completed the total study. Questionnaires were completed for both participants and nonparticipants of the study. Blood samples were obtained for complete blood count, blood smear, lead level, zinc protoporphyrin level, and reproductive hormone analysis. A semen analysis included sperm count, motility, morphology, hamster egg penetration, DNA analysis, and a vital analysis.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0025 28 September 1990

TITLE: Water Quality Analysis Set, Preventive Medicine

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F982 CONTRACT: WORK UNIT: 266

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USABRDL, SGRD-UBG-O, 2 Dec 88. subject: Field Water Medical Research Requirements, with 1st End, HQDA (SGPS-PSP), 24 Jan 89

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Howard, Gwendolyn G. COR:

OBJECTIVES: A Water Quality Analysis Set will be developed to measure physical and chemical parameters that cause adverse health effects and performance degradation of military field personnel.

APPROACH: The parameters, cyanide, magnesium, arsenic, sulfate, and chloride, have been identified by an Army Joint Working Group as having the potential for causing adverse health effects. The water quality analysis set will be able to determine each of these parameters. Both scientific and manufacturer literature will be searched to determine the best procedures available and whether existing off-the-shelf technology is satisfactory. Off-the-shelf procedures and equipment will be acquired and tested. Initial testing and evaluation will be conducted in the laboratory. For any parameters which cannot be determined, research and development will be solicited extramurally. The medical Water Quality Analysis Set will be assembled as a preliminary prototype and field tested using military personnel. Modifications will be made, and a fieldable prototype will be produced by an extramural contractor and tested by military personnel. An additional effort will be to develop a Water Sampling Submission Kit to be used to collect water samples that require further analysis by supporting laboratories for parameters which are beyond the capability of the Water Quality Analysis Set.

PROGRESS: Compilation of manufacturers' literature has provided information on commercially available procedures for measuring these parameters. Ion selective electrodes exist for the direct measurement of chloride and cyanide; however, magnesium can be measured only indirectly using a calcium and water hardness electrode. Arsenic and sulfate electrodes do not currently exist, and development is under consideration. Colorimetric and titrimetric tests are available for all parameters. These water testing kits have been purchased and are presently undergoing in-house testing. In addition, these test kits will be evaluated for stability under temperature and humidity extremes in accordance with AR 70-38.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0026 28 September 1990

TITLE: Hydrolysis, Disinfection, and Treatment Residuals for Biological Agents in Water

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F427 CONTRACT: WORK UNIT: 036

RAD: I TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Memorandum, USABRDL, SGRD-UBG-O, 2 Feb 88, subject: Field Water Medical Research and Development Requirements, with 1st End

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Burrows, W. Dickinson COR:

OBJECTIVES: The fate of biotoxins in water when subjected to Army field treatment technologies (disinfection, coagulation, and reverse osmosis) will be determined. The efficacy of these technologies for providing safe drinking water will be evaluated.

APPROACH: Four biotoxins will be investigated initially: ricin, T-2, saxitoxin, and microcystin. Treatments will include disinfection with chlorine at residuals of 1.0 to 10 mg/liter and with iodine, rejection by reverse osmosis, and precipitation by coagulation/flocculation with ferric chloride solution. Because of the scarcity of biotoxins and the resource requirements for bioassay, microscale techniques will be employed wherever possible; and special care will be taken to avoid redundant experiments. All experiments will be conducted with initially deionized water buffered as appropriate at ambient temperature. Disinfection studies will utilize 30-minute retention times. Coagulation/flocculation experiments, designed to simulate the ERDLator, will be carried out at pH 5, 7, and 9 (except for saxitoxin, for which a single test must suffice). Reverse osmosis studies will be conducted using the Survivor 06 desalinator with a Filmtec spiral-wound polyamide membrane to simulate the action of the reverse osmosis water purification unit (ROWPU). The degree of inactivation or removal of each biotoxin will be determined by mouse bioassay, except for T-2, for which a cell bioassay will be employed. Hydrolysis of these biotoxins is not anticipated; but if control samples exhibit inactivation, this subject will be pursued further.

PROGRESS: Disinfection at a free available chlorine level of 10 and 20 mg/liter or iodine at 18 mg/liter failed to produce detectable deactivation of any of the four biotoxins. Ricin and saxitoxin were deactivated at 100 mg/liter but not T-2 or microcystin. Total removal of all four was achieved by reverse osmosis, but coagulation/flocculation was ineffective.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0027 28 September 1990

TITLE: Chemical Composition of Fog Oil

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F978 CONTRACT: WORK UNIT: 241

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86 and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Rosencrance, Alan B. COR:

OBJECTIVES: The chemical composition of fog oil presently in the military supply system will be investigated. The chemical analysis of fog oil purchased under the "old" and "new" military specification will be compared with the chemical analysis of a nontoxic petroleum product such as mineral oil. This data will be used to draft a new military specifications for fog oil.

APPROACH: Chemical literature databases will be searched. An attempt will be made to correlate the presence or absence of functional groups, and other physical parameters, to the toxicity of fog oil. Fog oil samples will be collected from several Army units and shipped to the Laboratory. This will provide us with fog oil samples purchased using both "old" and "new" military specifications for fog oil. These samples will be used to develop analytical methods and to compare the aromatic and aliphatic content of a nontoxic petroleum product, such as mineral oil, with "old" and "new" fog oil. Parameters such as viscosity, UV absorbance at 280-289 nm, and aromatic content will be investigated as possible parameters for the development of new and safer military specifications for fog oil.

PROGRESS: A literature search yielded two possible analytical approaches. We evaluated both approaches and selected a FDA analytical test. Using the FDA method, we analyzed over 20 fog oil samples that we collected from Army warehouses within the continental United States. All samples except one were found to be contaminated with toxic aromatic compounds. The sample that was purchased using the "new" military specifications for fog oil was free of toxic aromatic compounds. The "new" military specifications for fog oil purchases is effective in eliminating toxic aromatic contaminants but has not been found to be widely used.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0028 28 September 1990

TITLE: Exposure Standards for Five Types of Smoke/Obscurants

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F996 CONTRACT: WORK UNIT: 272

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Memorandum, USAMRDC, SGRD-PLC, 8 Nov 88, subject: Health Hazard Assessment (HHA) Research Priorities

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Palmer, Winifred G. COR:

OBJECTIVES: This work will assess the health hazards associated with exposure to smokes/obscurants. Exposure guidelines will be recommended for those smokes for which sufficient information is available.

APPROACH: Recommended exposure standards will be based on health and exposure data published in reports and in the open scientific literature. Smokes/obscurants will be studied individually in the following order of priority: fog oil, hexachloroethane smoke, colored smokes (yellow, green, red, and violet), diesel fuel, and phosphorous/butyl rubber.

PROGRESS: The first draft of the Fog Oil Exposure Standard is complete. This report addresses health hazards associated with fog oil purchased before ("old" fog oil) and after ("new" fog oil) the military specifications were amended to exclude carcinogens in April, 1986. The following recommendations are made: (a) An exposure limit of 0.2 mg/m^3 for the benzene-soluble component of "old" fog oil should be adopted. This limit, is currently under consideration by the American Conference of Governmental Industrial Hygienist (ACGIH) for conventionally refined mineral oils and is based on the ACGIH standard for coal tar pitch volatiles. (b) Stockpiles of conventionally refined oils purchased before the military specifications were amended in April 1986 should no longer be used for production of obscurant smokes. (c) The military specifications for fog oils should be further amended to include a requirement for tests demonstrating the absence of carcinogens. Mutagenicity data and polycyclic aromatic hydrocarbon content should be provided. Acceptable methods are described. (d) The current inventory of "new" fog oil should be examined to ensure that all batches are carcinogen-free. (e) An 8-hour time weighted average exposure limit of 5 mg/m^3 (for the respirable fraction) should be adopted for carcinogen-free "new" fog oil. While some masking would be necessary with this permissible exposure level, the majority of soldiers would not be exposed to oil concentrations greater than 5 mg/m^3.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0029 28 September 1990

TITLE: Particle-sizing Technology for Use in Military Occupational Exposure Assessment

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: 979 CONTRACT NO.: WORK UNIT: 269

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Army Regulation 40-10, Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process, 15 Oct 83

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Young, John Y. COR:

OBJECTIVES: Research will identify the most suitable particle-sizing equipment and its optimum use in the evaluation of smoke and weapons combustion products in the military personnel exposure setting.

APPROACH: Research will begin with a literature search on particle-size distribution of airborne contaminants in military environments and various available particle-size selective sampling techniques for collecting respirable particulates and aerosols. Information can be obtained from technical experts and equipment manufacturers. Useful equipment for military field personnel exposure sampling will be purchased and evaluated. Several important airborne contaminants to be studied in the laboratory will include combustion products of small caliber weapons and various smoke and obscurant materials. Further investigations may be extended to field sampling during actual training or testing. Results will be useful for determining field particle sampling strategy and future research requirements in this area.

PROGRESS: The need for particle-size selective sampling to characterize military unique exposures has been identified, and initial equipment has been procured. The procured equipment included a miniature respirable aerosol monitor (miniRAM), a respirable aerosol monitor (RAM), a fibrous aerosol monitor (FAM), a multi-orifice uniform deposit impactor (MOUDI), and several respirable cyclone attachments. Initial evaluation of FAM uncovered a unique problem associated with the difficulty of the FAM in monitoring conductive materials in the open. The manufacturer was notified of the problem and steps to prevent short-circuiting the system were identified. The damaged FAM has been returned to the manufacturer for repair. The MOUDI has been found to be very effective for particle size distribution sampling. Both the miniRAM and the RAM are currently being evaluated, and no problems have been identified thus far.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0030 28 September 1990

TITLE: Evaluation Of Field Carbon Monoxide (CO) Monitors

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F974 CONTRACT: WORK UNIT: 267

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research And Development Command

PI: Terra, Joseph A. COR:

OBJECTIVE: The objective of this study is to compare the performance of CO instrumentation used in test operation procedure studies to more portable models used for field studies.

APPROACH: A literature search will be conducted to determine historical and state-of-the-art methodologies for determining CO. Also, a survey will be conducted of the manufacturers of CO monitoring equipment to determine features such as: portability, response time, interferences, principle of operation, ruggedness, range of operation, etc. Several portable CO monitors will be selected and purchased for evaluation by comparison with a Binos 4B.2 infrared bench-top CO monitor. The results from this study will be used to recommend portable CO monitors for future field studies. All pertinent data, recommendations, and comments will be included in a technical report.

PROGRESS: Criteria considered essential for a successful military field environment CO monitor were established for use as an acquisition guide. Those criteria include limitations on size, response time to 90 percent of total concentration (T90) and dynamic range. Several literature sources were used to identify manufacturers of air quality instrumentation for this survey. Over 90 air quality control equipment manufacturers were contacted through those sources. Fifteen manufacturers possessed CO monitors which approximated the established criteria. Of those, an Interscan Corporation CO monitor Model 4149 and a Neotronics of North America, Inc. CO monitor model CO 101 were considered the two best suited monitors on the basis of response times of T90 $\leq$ 20 seconds and dynamic ranges of which both exceeded 2000 ppm. Both of these monitors operate by means of electrochemical sensors, as does the Energy Efficiency Systems, Inc. CO monitor model Enerac-60, the USABRDL present means of monitoring CO in field environments. A Neotronics CO 101 and an Interscan 4149 have been purchased while a new electrochemical sensor has been installed in an Enerac-60 which was already on inventory at this Laboratory.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0031 28 September 1990

TITLE: Development of an Immuno-Assay Method for Detection of Pathogenic Microorganisms in Drinking Water

PROPONENT COMMAND(S):

APC: F103 CONTRACT: WORK UNIT: 220

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: 91C

REQUIREMENTS DOCUMENT: Letter, AHS, USA, HSHA-CDM, 16 Dec 88, subject: Draft Operational and Organizational Plan (O&O) for a Family of Medical Water Quality Monitoring Equipment (FMWQME)

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Hargett, Helen T. COR:

OBJECTIVES: The objective is to evaluate antigen-antibody reactions in water using laser spectrophotometry and chromogenic detection systems to determine if they could rapidly determine microbial pathogens under military field conditions.

APPROACH: The DAWN Model F laser spectrophotometer (Wyatt Laboratory) will be used. The laser system directs a high intensity beam at the illuminated sample by means of a special narrow beam diameter. Fecal coliform antibody bound to microbeads will be reacted with an antigen. When a sample is injected into the flow cell of the photometer, an agglutination-precipitation reaction should be reflected by a change in the light-scattering pattern. If a method for detection of fecal coliform bacteria can be developed, viral and protozoan reactions will be evaluated. Also, ELISA and other chromogenic antibody reactivity systems to waterborne antigens will be examined in a similar manner.

PROGRESS: Preliminary studies using Polio virus and Escherichia coli bacteria indicate the Dawn F laser can be used to detect antigen-antibody interactions. Latex beads for binding viral and bacterial antisera have arrived. Cryptosporidium parvum hyperimmunized calf serum has been purified, and the beads are on order for antigen-antibody studies.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0032 28 September 1990

TITLE: Enzyme-Electrodes for the Rapid and Real-time Detection of Bacteria in Water

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F102 CONTRACT: WORK UNIT: 221

RAD: III TYPE OF FUNDING: ILIR PROJ/TASK: 91C

REQUIREMENTS DOCUMENTATION: Inter-Laboratory Innovative Research

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Schaub, Stephen A. COR:

OBJECTIVES: The objective is to develop and evaluate enzyme-probes to detect specific bacteria based upon their substrate-utilization patterns or biochemical end-product profile. The probes developed would be able to specifically and rapidly detect viable, metabolically active bacteria.

APPROACH: Enzymes whose catalytic properties result in end-products which can be detected by commercially available electrochemical devices (such as pH, oxygen, ammonium ion, etc.) will be immobilized by several different available techniques such as glutaraldehyde cross-linking, surface adsorption, etc. Enzyme electrode combinations will be such that coliform bacteria will be detected based on their metabolic properties. For instance, coliforms organisms may be detected based on lactose fermentation and the formation of gas. Therefore, a probe which can detect a decrease in lactose added to a water sample would indicate the presence of coliform bacteria. In addition, since all organisms can utilize glucose, an enzyme-electrode combination which could also detect the utilization of glucose would give an indication of overall metabolic activity and therefore, microbiological activity of samples. The probes when developed will be evaluated for the detection of bacterial pathogens in drinking water.

PROGRESS: A preliminary literature and product search identified several electrode systems with promise. Initial experiments indicate that the enzyme electrodes are sensitive methods to specifically determine the concentration of solutes. The electrodes, however, were found to be somewhat temperamental and affected by conditions which would normally be uncontrollable under field water conditions. Operational conditions also affected sensitivity, e.g., a lactose electrode gave variable results based upon the rate of stirring and type of stir-bar used.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0033 28 September 1990

TITLE: Assessment of Exhaust Products from STINGER Missile Firing

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: 973 CONTRACT: WORK UNIT:

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 2º May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Allen, Joseph T. COR:

OBJECTIVES: The objective is to develop and implement methods to sample and characterize the weapon combustion products of a STINGER Missile. These findings will be used to determine the extent of hazard, if any, which could lead to adverse health effects. Training and combat scenarios under a variety of meteorological conditions will be used in the research plan to better understand the complete weapon system exposure.

APPROACH: Except for HCl and CO, the exposure to other constituents of STINGER exhaust components have not been analyzed. In chamber studies sampling for complete characterization was completed in June and July 1989 by Oak Ridge National Laboratory. Analysis of the propellant metal content has been completed. Major constituents included aluminum, cadmium, chromium, copper, and lead. Field studies will include sampling for these metals as well as organic vapors and PAHs and will include sampling efforts in hot dry climates, inversion conditions and cold weather conditions.

PROGRESS: Sampling was conducted at White Sands Missile Range which was in an extremely hot dry climate. The weapons combustion products were thoroughly characterized during these test firings. The second phase of this project involves test firings in a climate with meteorological condition approximating stability condition F which is an inversion in a warm temperature area. Aberdeen Proving Ground has been choosen for phase two and the test firings and sampling efforts are set for early 1st Quarter 91. Phase three is being planned involving test firings and sampling in an extremely cold climate during 2nd Quarter 91.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0034 28 September 1990

TITLE: Evaluation of Breathing-zone Exposure to Rocket and Missile Exhaust Combustion Products

PROPONENT COMMAND(S): U.S. Army Missile Command (USAMICOM), and U.S. Army Medical Research and Development Command

APC: 994 CONTRACT: WORK UNIT:

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: REIMB

REQUIREMENTS DOCUMENT: Army Regulation 40-10, Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process, 15 October 1983, and memorandum, U.S. Army Missile Command, AMCPM-AM-E, 30 November 1989, subject: Biomedical Research for Multi-Purpose Individual Munition (MPIM)

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Young, John Y. COR:

OBJECTIVES: The overall objective is to develop a data base on potential exposure to airborne combustion products from test firing of rockets and missiles. Specific to the current MPIM development, the objectives are to evaluate short-term exposure to airborne combustion products unique to the type of propellants used in the MPIM, to develop military specifications based on the findings, and to address research issues related to the health hazard assessment program toward the procurement and production of the weapon system.

APPROACH: USABRDL will support USAMICOM during the development of the Multi-Purpose Individual Munition (MPIM). Initial efforts will include an evaluation of combustion products from three propellant candidates for the system, with subsequent evalaution of air sampling from actual test firing. USABRDL will provide inputs to USAMICOM to guide and formulate health effects criteria related to the design of the MPIM system during the Proof of Principle Phase, and will assist in establishing procurement specifications for the MPIM during the Development Proveout Phase. Additional research needs on proposed, new, or improved rocket and missile systems will be identified.

PROGRESS: In this short reporting period, USABRDL has begun initial planning for medical research on health hazard assessment to support acquisition decision process for the multi-purpose individual munition (MPIM). Air sampling data collected during the proof of principle missile firing had been received and are being evaluated. Characterization of combustion products from two of the three candidate propellants proposed for the MPIM was performed under a separate extramural contract in the Army Signature Characterization Facility. The collected air samples are being analyzed.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0035 28 September 1990

TITLE: Molecular Effects of Water Disinfectants

PROPONENT COMMANDS: U.S. Army Medical Research and Development Command

APC: F104 CONTRACT: WORK UNIT:

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: 91C

REQUIREMENTS DOCUMENTATION: In-house Laboratory Independent Research

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Schaub, Stephen A. COR:

OBJECTIVES: The objectives are to determine the molecular effects on microorganisms by disinfectants commonly used by the Army under field conditions. Correlations will be made for reductions in microorganism viability versus alterations in DNA and protein structure in the presence of disinfectant.

APPROACH: Clones of DNA from E. coli representing the B-galactosidase region in the form of a plasmid, DNA from strains of lambda coliphage, and cDNA clones of poliovirus genomic RNA have been obtained for studying the disinfection mechanisms. These DNA molecules will be utilized as markers and probes to study the molecular effects of the disinfectants on the respective test microorganisms (E. coli, coliphage lambda, and poliovirus). Initial studies will examine the effects of disinfectants on the general structure of DNA or RNA isolated from the respective test microorganisms. Other studies will correlate the reduction in viable bacteria, coliphage, and poliovirus to specific DNA or RNA alterations.

PROGRESS: Studies were conducted to determine the effects of chlorine dioxide disinfectant (2-9 mg/L) on the integrity of protein and RNA of poliovirus at various times of disinfection up to 10 minutes, in which up to a 99.9 percent reduction in virus infectivity on cell culture was observed. Results with polyacrylamide gel electrophoresis (protein analysis) and slot blot hybridization (RNA analysis) indicated that there was no discernable difference in selectivity of chlorine dioxide's attack on the two poliovirus components, as both were effected in their structure within the same time period correlating with reduced virus infectivity.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0036 28 September 1990

TITLE: A Study of the Mutagenicity of Urine from Soldiers Exposed to "Old" Fog Oil

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F105 CONTRACT NO.: WORK UNIT: 275

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: 91C

REQUIREMENTS DOCUMENT: In-house Laboratory Independent Research

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Palmer, Winifred G. COR:

OBJECTIVES: In April 1986, the military specifications for fog oil were modified to exclude all "carcinogenic or potentially carcinogenic constituents." Although the Army currently only purchases fog oil that meets the revised specifications ("new" fog oil), batches of "old" fog oil are stockpiled and may be used in training operations at some military bases. This project will examine whether absorption of polycyclic aromatic hydrocarbons following exposure to "old" fog oil may cause the appearance of mutagens in urine.

APPROACH: Urine will be collected and analyzed from soldiers exposed to "old" fog oil. To maximize the opportunity to find urinary mutagens, soldiers will be studied who have had repeated exposure for at least 6 months. Only nonsmokers will be included in the study. Urine samples will be collected before and after smoke exposure. Urine samples will be frozen immediately after collection and returned to Maryland for mutagenicity testing. Concurrent atmospheric and/or breathing-zone oil mist concentrations will be measured to enable estimation of external dose. Before urine samples are collected, the type of fog oil in use will be determined. Samples of fog oil will be brought back at the end of the sample collection for verification. The PAH content of the sample will be estimated from the ratio of the absorbance at 280 and 289 nm using the method developed by the Food and Drug Administration for testing white oil purity. The Ames test will be performed under an interagency agreement with the Frederick Cancer Research Facility under the direction of Dr. A.W. Andrews. If results with "old" fog oil are positive, urine from soldiers exposed to "new" fog oil will be used as a negative control.

PROGRESS: Efforts are in progress to identify training exercises which use "old" fog oil and are otherwise suitable for the study.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRI-0037 28 September 1990

TITLE: An In Vitro Study of the Mutagenicity of Propellant Combustion Products

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F991 CONTRACT NO.: WORK UNIT: 254

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End USAMRDC, SGRD-PLC, 25 June 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Palmer, Winifred G. COR:

OBJECTIVES: The objective is to establish the mutagenic characteristics of propellant emissions from the M16 rifle, a double-based propellant test system.

APPROACH: This study will examine the mutagenicity of gas phase and solid phase emissions from the M16 rifle. The rifle will be housed in a chamber constructed for the purpose of collecting samples of propellant emissions after firing. Use of the chamber will allow consistent production of sample for analysis. Gas phase emissions will be collected in a desiccator flask immediately after firing. Particulates will be collected on filters and dispersed in dimethylsulfoxide (DMSO) prior to testing. All gas phase and particulate samples will be tested with and without metabolic activation enzymes and with two strains (TA 98 and TA 100) of Salmonella typhimurium. If the DMSO-soluble material is positive in the Ames test, it will be further fractionated by reverse phase high pressure liquid chromatography (HPLC). Fractions recovered from HPLC will be concentrated and subjected to the Ames test. Those fractions testing positive in the Ames test will be analyzed and their components identified by GC/MS.

PROGRESS: Preliminary experiments have been conducted with the particulate fraction. They indicate that mutagens may be associated with gunsmoke particulates.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5001 28 September 1990

TITLE: Toxicity Studies on Agents GB and GD (Phase II)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 85PP5868 WORK UNIT: 312

RAD: V, III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMBRDL, SGRD-UBG-M, 15 Dec 83, subject: Health Effects Research in Medical Defense Against Chemical Agents, with 1st End, USAMRDC, SGRD-PLE, 23 Feb 84

LOCATION: National Center for Toxicological Research (NCTR), Jefferson, AR

PI: Bucci, Thomas J. COR: Dacre, Jack C.

OBJECTIVES: The toxic, reproductive, subchronic dominant lethal and delayed neuropathic potential and health hazards of agents Sarin (GB) and Soman (GD) will be investigated. These data will provide part of a toxicological data base for defining occupational health standards for workers and combat personnel involved in transportations, storage, demilitarization, and exposure to these compounds.

APPROACH: The delayed neuropathy study in chickens (single and multiple doses) and 90-day subchronic in rats will be performed.

PROGRESS: Preliminary conclusions from the completed delayed neuropathy studies on GB I and II and GD show that there are no statistically significant differences between the vehicle controls and the treated groups in ataxia scores or histopathology. They did not show a significant decrease in brain neurotoxic esterase (NTE) but did show decreased activity of plasma and brain cholinesterase and caraboxylesterase. Agent GB II showed a dose-related trend in the lymphocyte NTE (to 33 percent of the control at 280 mg/kg dose) suggesting that a longer exposure to lower doses might cause a cumulative neurotoxic effect. Preliminary conclusions from the 90-day subchronic studies on GB I and II and GD indicate negative toxic effects in all the parameters examined, but no observable effect levels can be established for the three agents. Draft reports on all these studies are in preparation. The first draft report, "Reproductive Study in Rats of GB I," has been completed and is undergoing final review at NCTR.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5002 28 September 1990

TITLE: Continuing Toxicological Studies of Agents GB and GA (Phase II)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 87PP7831 WORK UNIT: 311

RAD: V TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Deposition Form, USAMRDC, SGRD-PLE, 17 Sep 85, subject: Toxicity Studies on Agent GA

LOCATION: National Center for Toxicological Research (NCTR), Jefferson, AR

PI: Bucci, Thomas J. COR: Dacre, Jack C.

OBJECTIVES: The toxic, reproductive, teratogenic, and subchronic potential and health hazards of chemical agents Tabun (GA) and Sarin (GB) will be investigated. These studies will produce part of a toxicological data base for defining occupational health standards for munition workers and combat personnel involved in the transportation, storage, demilitarization, and exposure to this compound.

APPROACH: The toxicological evaluation of GB II will be completed using the modified dominant lethal study in rats, the reproductive assessment by continuous breeding (RACB) study in rats. The effects of GA will be evaluated using the RACB study in rats, a modified dominant lethal study in rats, the developmental toxicity (teratology) study in rats and rabbits, and the 90-day subchronic study in rats.

PROGRESS: Agent GA range-finding studies in rats have been completed. The teratology studies in rats and rabbits has been completed. The experimental phase of the 90-day subchronic study in rats has been completed. Preliminary results of all these studies indicate that GA does not produce any toxic effects. Statistical evaluation and Quality Assurance of the raw data from all these studies is in progress. Report preparation is also in progress.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5004 28 September 1990

TITLE: Characterization of Rocket Propellant Combustion Products

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command, and U.S. Army Missile Command

APC: CONTRACT: 87PP7874 WORK UNIT: 282

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN

PI: Jenkins, Roger A. COR: Young, John Y.

OBJECTIVES: Research will chemically define the composition of exhaust products that may affect human health/performance from typical rocket/missile propellants; and results will be compared with applicable thermodynamic computer models.

APPROACH: Available literature will be reviewed to determine appropriate methodology for characterizing exhaust products from the use of rocket/missile propellants. Instrumentation for chemical and physical analyses will be tested in a laboratory chamber. Actual field sampling will be performed using simulated launch motors detonated in the Army Signature Characterization Facility at U.S. Army Missile Command (USAMICOM). Sampling results will be used for health hazard assessment. The second part of this project is to apply the sampling results in computer modeling, to test fit the National Aeronautics and Space Administration - Lewis thermodynamic prediction model, to improve prediction with a revised version, or to develop appropriate models for exhaust products prediction.

PROGRESS: The air sampling phase of this project is complete. Chemical analyses for all samplings are near completion. Computer modeling using some of the air sampling data has begun. In the computerized modeling efforts, general agreements exist between the NASA-Lewis modeling prediction data and the actual field sampling results on the first three propellants that were tested. The Oak Ridge National Laboratory has consolidated and updated the data on the exhaust combustion products for the M36 propellant with a full report being distributed to all concerned. A report to document sampling and analysis procedures for the project has been prepared and reviewed. The sampling and analysis procedure report will be included as a part of the project final report.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5005 28 September 1990

TITLE: Data Base Assessment of Environmental and Toxicological Factors in Water to Upgrade and Modernize Content of TB MED 577

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 82PP2817 WORK UNIT: 096

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 8 Dec 86, subject: Guidance for Medical Research and Development to Ensure Potability and Palatability of Combat Water Supplies

LOCATION: Lawrence Livermore National Laboratory, Livermore, CA

PI: Anspaugh, Lynn R. COR: Schaub, Stephen A.

OBJECTIVES: The study will perform an evaluation of the current technical data base on health related waterborne constituents in field water.

APPROACH: Important waterborne constituents will be identified based upon occurrence, treatment, health impact, and risk to accomplishment of missions. Appropriate methodologies for preparing health criteria will be used to develop standards based upon exposure duration, concentrations, and acceptable troop performance for combat.

PROGRESS: Final revisions to Volume 4, Part 2 and Volume 5 of the final report have been received from the contractor and the USABRDL has sent a letter transmitting the NBC agent and microbiological standard recommendations (with this Laboratory's opinion on the acceptability of the standards) to the Office of the Surgeon General. A meeting will be held at the Surgeon general's Office with Navy and Air Force participation to establish joint service agent and microbiological indicator standards. Draft Volumes 1 and 8 have been received from the contractor and are in review at the Army. All final report deliverables have been received by the Army at least as a draft.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5006 28 September 1990

TITLE: Evaluation of Dermal Toxicity of Liquid Gun Propellant, LP 1846

PROPONENT COMMAND(S): U.S. Army Ballistics Research Laboratory

APC: CONTRACT: 87PP7806 WORK UNIT: 294

RAD: III TYPE OF FUNDING: REIMB PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, AMXBR-IBD, U.S. Army Ballistics Research Laboratory, 27 Mar 85, subject: Review of HAN-Based Liquid Propellants, with 3d End, OTSG, DASG-PSP, 14 May 85

LOCATION: Battelle Pacific Northwest Laboratory, Richland, WA

PI: Weller, Richard COR: Finch, Robert A.

OBJECTIVES: The objective is to determine the dermal toxicity and systemic toxicity, by the dermal route of exposure, of LP 1846. Also, the dermal sensitization and genotoxic potential of LP 1846 will be determined.

APPROACH: In the first study, swine were exposed to LP 1846 over approximately 15 percent of their skin surface by dermal application and by application of a saturated fabric patch. The dermal sensitization study was performed using Hartley guinea pigs according to standard methodology. Genotoxicity of LP 1846 was to be evaluated in three in vitro genotoxicity assays.

PROGRESS: The definitive dermal/systemic toxicity study in the mini-swine and the other two in vitro genotoxicity assays will not be performed because of insufficient funds and has been transferred to another research activity. The results of the skin sensitization study indicate that the LP 1846 is a strong dermal sensitizer. The results obtained from the incomplete CHO/HGPRT Forward Mutation Assay suggest that LP 1846 is weakly mutagenic at 1.25 mg/mL in the absence of a metabolic activation system. The results of the pilot dermal/systemic toxicity study in the mini-swine indicate that the LP 1846 penetrates the skin and can cause severe systemic effects when applied undiluted to approximately 15 percent of the total skin surface. Within 8-16 hours after the first exposure, the exposed animals showed methemoglobin levels of approximately 20 percent. By 8 hours after the second exposure, which occurred 24 hours after the first, methemoglobin levels had reached approximately 60 percent; and the animals were moribund with cyanosis, tachypnea, and vomiting. Within 10 hours of the second exposure, three of the four exposed animals were dead; the fourth was near death. A final project report describing the results has been reviewed and accepted with final corrections and revisions. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5007 28 September 1990

TITLE: Human Health Studies of Carbon Monoxide (CO) Under Conditions of Military Weapons System Crewman Exposure

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 81PP1811 WORK UNIT: 286

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 7 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Environmental Protection Agency, Chapel Hill, NC

PI: Benignus, Vernon A. COR: Parmer, David L.

OBJECTIVES: The project objective is to develop an improved biomedical data base on the physiologic effects of CO exposure and the relationship of CO exposure to carboxyhemoglobin (COHb) formation in man, focusing on military-relevant workload and CO concentration profiles associated with field weapons.

APPROACH: Human clinical study protocols culminating in a field research study will be conducted. The protocols will be designed to achieve a biomedical data base relevant to military workload parameters and CO exposure profiles associated with ground and aircraft weapons systems. Concurrent emphasis is on refining/validating the modeling algorithm for predicting COHb levels in man; and human study protocols will be designed and conducted to focus on the key parameters of existing algorithms, with empirical data endpoints designed to achieve an improved algorithm for military design and operation compliance testing with the current COHb standards.

PROGRESS: Sixteen subjects were tested in the second protocol for this study. The mean exposure of 1 percent CO for 4.7 minutes at a ventilation rate of 10 l/min raised venous blood to 15.3 percent COHb and arterial blood COHb to 18.1 percent on average. The data for each of the variables has been extensively analyzed to ensure a correct mass balance for gas and blood values, especially to verify that the difference between COHb values in venous and arterial blood is real and not an artifact. When experimental results are compared with modeled values before two minutes have elapsed, arterial values are always higher and venous values are always lower than predicted, but the weighted mean is not significantly different than the predicted values. After two minutes predicted and actual are usually the same, although some individuals take 5-6 minutes to reach equilibrium. The physiological significance of the higher arterial values is unknown.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5008 28 September 1990

TITLE: Neurobehavioral Effects of Carbon Monoxide (CO) Exposure to Humans

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 81PP1812 WORK UNIT: 287

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Environmental Protection Agency (EPA), Chapel Hill, NC

PI: Benignus, Vernon A. COR: Parmer, David L.

OBJECTIVES: The study will evaluate the neurobehavioral effects of CO exposure in humans in order to identify and assess military crew performance.

APPROACH: Through a sequence of human clinical study protocols, the neurobehavioral effects of CO exposure in young healthy volunteers will be evaluated. Performance parameters under evaluation will include perceptual, vigilance, psychomotor, and selected physiological variables.

PROGRESS: Final reports entitled "Compensatory Tracking in Humans with Elevated Carboxyhemoglobin" and "Dose-effects Functions for Carboxyhemoglobin and Behavior" have been published in journals. A report entitled "Elevated Carboxyhemoglobin (COHb) and Cerebrovascular Responses" has been completed as a contract technical report. A preliminary draft report on requirements for conducting field neurobehavioral trials has been reviewed and returned to EPA. A human use protocol for testing of a field experimental face mask has been submitted to the Army Human Subjects Review Office for approval. The face mask study will be the final effort for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5009 28 September 1990

TITLE: Toxicity of Red and Violet Dyes in M18 Grenade

PROPONENT COMMAND(S): U.S. Army Materiel Command (PM Smoke/Obscurants)

APC: CONTRACT: 87PP7808 WORK UNIT: None

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: REIMB

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Environmental Protection Agency, Health Effects Research Laboratory, Research Triangle Park, NC

PI: Costa, Daniel L. COR: Eaton, James C.

OBJECTIVES: The study will evaluate the potential toxicity of the red and violet dyes used in the product-improved M18 colored smoke grenade.

APPROACH: The major effort in this project is a three-phase study of the inhalation toxicology in rats of aerosolized red and violet dye mixtures that are intended for use in the product-improved M18 smoke grenade. Effects to be studied are those relating to pulmonary function and structure, genotoxicity, and immuno-hypersensitivity.

PROGRESS: All work on the inhalation toxicity of the violet dye mixture has been completed, and a final report on the findings of that portion of the study is in preparation. The second and third phases of the inhalation exposures of rats to the red dye mixture have been completed, and there were some dose-related changes in lung function and liver enzymes. The red dye mixture was not retained in the lungs of rats at the highest dose level. The results of histopathological examination of the exposed animals are not yet available. No immunohypersensitivity reaction has been evoked by skin and inhalation exposures to either dye mixture, but these tests are not yet complete.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5011 28 September 1990

TITLE: Inhalation Toxicity of Single Materials and Mixtures

PROPONENT COMMAND(S): U.S. Army Ammunition and Chemical Command (Project Manager (PM) Smoke/Obscurants)

APC: CONTRACT: DAMD17-89-C-9043 WORK UNIT: 289

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: REIMB

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: IIT Research Institute (IITRI), Chicago, IL

PI: Aranyi, Catherine COR: Dacre, Jack C.

OBJECTIVES: The project will evaluate the toxicity of single materials and mixtures of materials by exposing laboratory rodents to aerosols in inhalation chambers under conditions which simulate actual exposures experienced by soldiers in the field.

APPROACH: A laboratory-scale generator capable of producing both liquid and solid particulate aerosols will be installed in inhalation chambers, and the atmosphere will be standardized (Phase I). Fischer 344 rats will be exposed to a single material for 4 weeks (Phase II), a mixture of materials for 4 weeks (Phase III), and the same mixture for 13 weeks (Phase IV). The animals will be observed and a wide range of tissue and organ samples analyzed for acute and chronic effects as a result of the exposure. The final product will be a report describing the health effects of exposures to various durations, frequencies, and concentrations of the aerosols.

PROGRESS: The draft final report on Phase I of the study was received and reviewed. The final report, "Phase I - Design and Characterization of Animal Exposure Facility" has been received. The report is excellent and shows that the chamber atmospheres are homogeneous and that monitoring methods are effective. The protocol for the Phase II study, "Four-week Repeated Dose Inhalation Toxicity Study with Aerosols of a Solid Particulate Test Material in Male and Female F344/N Rats," to evaluate the effects of exposure concentration, duration, frequency, and recovery time on various endpoints is undergoing reviews. Although initiation of Phase II was delayed due to building renovations at IITRI, it is now planned to start the inhalation exposure of the rats on 1 October 1990.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5013 28 September 1990

TITLE: Evaluation of Weapons Combustion Products in Armored Vehicles

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-86-C-6245 WORK UNIT: 285

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 7 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, OTSG, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Arthur D. Little, Inc., Cambridge, MA

PI: Menzies, Kenneth T. COR: Young, John Y.

OBJECTIVES: The composition of propellant combustion products resulting from weapons firing in selected armored vehicles will be characterized by using personal dosimetry sampling techniques, and the extent of crew exposures to the combustion products will be evaluated.

APPROACH: Air samples will be collected both from crew compartment spaces and on crew members in armored vehicles at the commander's position, the gunner/loader locations, and the driver's compartment. Breathing zone samples will be collected by using portable air sampling equipment fitted into specially designed survival vests worn by crew members. Air sampling will include both Army schools and field unit training. Armored vehicles to be studied include the M1 and M60 tanks, the M2/3 Bradley fighting vehicles, and the M109 self-propelled howitzer. Analyses will be performed on major combustion products to include carbon monoxide (CO) and oxides of nitrogen, and minor chemical constituents such as metals, hydrogen cyanide, ammonia, and trace organic volatiles including polycyclic aromatic hydrocarbon compounds.

PROGRESS: Corrections to the findings of this project were summarized in the previous information paper. All pollutants except CO were at concentrations well below their threshold limit values. Peak CO levels ranged from 10 to greater than 2,000 parts per million (ppm), with mean levels ranging from 3.6 to 4.7 ppm in the M3 Bradley fighting vehicles and the M109 howitzers. Considerably higher CO levels were found in the M1 and the M60 tanks; and on several occasions, the levels remained 400 ppm for 15 minutes. These major corrections to the final report were reflected in the revised pages provided to USABRDL. Final report and appendices with Defense Technical Information Center numbers AD-A208552, AD-A208553, and AD-A208554 have been published. This is the last information paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5014 28 September 1990

TITLE: Lead Exposures and Biological Responses in Military Weapons Systems

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 86PP6821 WORK UNIT: 288

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Argonne National Laboratory, Chicago, IL

PI: Bhattacharyya, M.H. COR: Eaton, James C.

OBJECTIVES: The study will characterize lead exposures in military environments.

APPROACH: Pilot studies are to be conducted to examine all forms of lead sources, lead species, and lead exposures in armored vehicles. The principal studies will correlate measurements of lead in air with measurements of blood lead, hematocrit, erythrocyte protoporphyrin, and nerve conduction velocity (NCV). Prospective epidemiological studies will be conducted on artillerymen of 5, 10, and 15 years of service to provide a measure of cumulative lead exposure. Measurements of bone lead, blood pressure, blood lead, and NCV will be made in the chronic study.

PROGRESS: A draft final report on the physical and chemical characteristics of the 8-inch and 155MM howitzer, and on physiological responses to exposure of the 8-inch howitzer have been prepared by Argonne National Laboratory (ANL), reviewed by the laboratory and returned for corrections. A revised draft is expected in the 1Qtr, FY91. Preliminary investigations on the chronic effects study were conducted at Ft. Hood, TX during the week of 23-27 July 1990. Because of time limitations imposed by Ft. Hood, only 48 subjects out of a total requirement of 120 were inducted into the program. Only two of the lead exposed subjects were found to have significant levels of bone lead. Analysis of the remaining data is underway.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5015 28 September 1990

TITLE: Inactivation of Hepatitis A Virus (HAV) by Chlorine and Iodine in Water

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-86-C-6053 WORK UNIT: 293

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 8 Dec 86, subject: Guidance for Medical Research to Ensure Potability and Palatability of Combat Water Supplies

LOCATION: University of North Carolina, Chapel Hill, NC

PI: Sobsey, Mark D. COR: Schaub, Stephen A.

OBJECTIVES: The kinetics of disinfection of HAV in water with chlorine and iodine disinfectants used by the Army in the Field will be quantitatively determined. Also, the relative disinfection efficiency of HAV will be compared with other enteroviruses and indicator microorganisms.

APPROACH: Free available chlorine from calcium hypochlorite and iodine (Army issue tablets) will be used at typical field water disinfectant levels to quantitatively characterize kinetic disinfection profiles of HAV, polio, and ECHO viruses over a 5 log inactivation range. Water challenges will be buffered-distilled water, well water, and a worst case mixture containing five NTU bentonite, and 10 mg/L of humic-fulvic acids. All disinfection experiments will be conducted at temperatures of 5 and 25^{0} C, and pHs of 4.5, 7.0 and 9.5.

PROGRESS: All facets of the research have been completed, and the draft final report has been reviewed by the Army and accepted with minor revisions. The contractor is making final changes to the report.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5016 28 September 1990

TITLE: Toxicity Studies on Lewisite and Sulfur Mustard Agents

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 84PP4865 WORK UNIT: 003

RAD: V TYPE OF FUNDING: 6.2 PROJ/TASK: 993CP

REQUIREMENTS DOCUMENT: Letter, USAMBRDL, SGRD-UBG-M, 15 Dec 83, subject: Health Effects Research in Medical Defense Against Chemical Agents, with 1st End, USAMRDC, SGRD-PLC, 23 Feb 84

LOCATION: Battelle Pacific Northwest Laboratory, Richland, WA

PI: Sasser, Lyle B. COR: Dacre, Jack C.

OBJECTIVES: The mutagenic, reproductive, subchronic, dominant lethal, and health hazard potential of Lewisite (L) and sulfur mustard (HD) will be investigated. These studies will produce part of a toxicological data base for defining occupational health stardards for munitions workers and combat personnel.

APPROACH: Ames salmonella/microsome mutagenicity assay, Chinese hamster ovary (CHO) cell forward mutation assay, sister chromatid exchange assay, two-generation reproduction assay, dominant lethal assay (mustard only), and a 90-day subchronic study will be performed.

PROGRESS: All studies have been completed; all final reports have been received from the contractor, and distribution has been made. The reports are titled as follows: Mutagenicity of Sulfur Mustard in the Salmonella Histidine Reversion Assay; Mutagenicity of Lewisite in the Salmonella Histidine Reversion Assay; Genetic Toxicity of Sulfur Mustard in the Chinese Hamster Ovary Cells; Genetic Toxicity of Lewisite in the Chinese Hamster Ovary Cells; Subchronic Toxicity of Sulfur Mustard in Rats; Subchronic Toxicity of Lewisite in Rats; Reproductive Assessment by Continuous Breeding (RACB) of Sulfur Mustard in Rats; Reproductive Assessment by Continuous Breeding (RACB) of Lewisite in Rats; and Modified Dominant Lethal Study of Sulfur Mustard in Rats. The results of the mutagenesis assay studies for both sulfur mustard and Lewisite were all negative except that sulfur mustard was weakly positive in the Ames assay and in the CHO mutation assay. No-observable effect levels have been established in the subchronic, RACB rat studies, and the teratology studies in rats and rabbits. The principal toxicological effects observed at the higher dose levels were forestomach lesions (subchronic and two-generation studies), and maternal and fetal effects (teratology studies). This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5017 28 September 1990

TITLE: Toxicity Studies on Agent GA (Phase I)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 87PP7827 WORK UNIT: 263

RAD: V TYPE OF FUNDING: 6.2 PROJ/TASK: 875AG

REQUIREMENTS DOCUMENT: Deposition Form USAMRDC, SGRD-PLE, 17 Sep 85, subject: Toxicity Studies on Agent GA

LOCATION: Laboratory for Energy-Related Health Research, University of California, Davis, CA

PI: Wilson, Barry W. COR: Dacre, Jack C.

OBJECTIVES: The toxic, tagenic, and delayed neuropathic potential and health hazards of chemical agent Tabun (GA) will be investigated. These data will provide part of a toxicological data base for defining occupational health standards for munitions workers and combat personnel involved in the transportation, storage demilitarization, and exposure to this compound.

APPROACH: The Ames salmonella/microsome mutagenicity assay, mouse lymphoma forward mutation assay, sister chromatid exchange assay, chromosome aberration assay, unscheduled deoxyribonucleic acid (DNA) synthesis assay, and a delayed neuropathy study (single and multiple doses) in chickens will be performed.

PROGRESS: The following three final reports have been received from the principal investigator and final distribution has been made: 1. Unscheduled DNA Synthesis in Rat Hepatocytes After Exposure to GA (Tabun), 2. Mutagenicity of Agent GA (Tabun) in the Mouse Lymphoma Assay, and 3. Mutagenicity of Agent GA (Tabun) in the in vitro Cytogenic Test Sister Chromatid Exchange. Results in the unscheduled DNA assay were negative. Results for the mouse lymphoma assay showed a linear dose-mutagenic response to GA without S9 activation but addition of S9 did not enhance the dose-mutation response. Results for the in vitro cytogenic assay indicate that GA was both toxic to cells at high dose levels and behaved as a weak mutagen. Sister chromatid exchanges increased linearly with the concentrations of GA but was never more than twice the number of the controls. Experimental work on the remaining three studies has been completed, and final reports have been received. Negative results were obtained in the sister chromatid exchange assay and the delayed neuropathy study in chickens (both single and multiple doses of GA). A weakly positive result was obtained in the Ames salmonella assay. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5018 28 September 1990

TITLE: Developmental Toxicity (Dominant Lethal Mutation) Study on Agent Lewisite

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 88PP8860 WORK UNIT: 261

RAD: V TYPE OF FUNDING: 6.2 PROJ/TASK: 875AG

REQUIREMENTS DOCUMENT: Letter, USAMBRDL, SGRD-UBG-M, 15 Dec 83, subject: Health Effects Research Against Chemical Agents, with 1st End, USAMRDC, SGRD-PLE, 23 Feb 84

LOCATION: National Center for Toxicological Research (NCTR), Jefferson, AR

PI: Bucci, Thomas J. COR: Dacre, Jack C.

OBJECTIVES: The dominant lethality effect of the agent Lewisite on reproduction in male rats will be investigated.

APPROACH: Adult male rats are dosed acutely with sublethal concentrations of the agent. The treated males are then mated sequentially (by weeks) with groups of untreated females. The results of the weekly matings will indicate the specific stages of gametogenesis that are damaged and hence responsible for the resultant embryonic mortality.

PROGRESS: The original dominant lethal mutation protocol for this study has been revised to conform with the Environmental Protection Agency "Proposed Guidelines for Assessing Male Reproductive Risks," (Federal Regulation, 30 June 1988, Volume 53, Number 126, pages 24850-24869). The standing operating procedure development for the computer assisted sperm analysis system has been completed. The experimental work has been completed, and the data is undergoing statistical and quality assurance review analysis.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5019 28 September 1990

TITLE: Combustion Product Evaluation of Various Charge Sizes and Propellant Formulations

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 88C8006 WORK UNIT: 304

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: IIT Research Institute, Chicago, IL

PI: Snelson, Alan COR: Hoke, Steven H.

OBJECTIVES: The study will determine how the production of nonequilibrium, relatively minor, yet toxic species such as oxides of nitrogen, hydrogen cyanide, and formaldehyde produced by military propellants scale with the size of the charge; and determine the relationship between propellant formulations and resulting combustion products.

APPROACH: Small, medium and large caliber weapons will be evaluated to determine the chemical composition of breech gases. Methodological approaches will be developed for: (a) analyzing breech and spent casing emissions, (b) determining how the production of nonequilibrium minor and trace species scale with the size of the charge, and (c) inventorying combustion products from specified propellant and modeling the occurrence of these products.

PROGRESS: The contract was modified to add an additional $3,646.00. These funds were used to cover extended field work due to bad weather, to improve the quality of photographs in the final report, and to perform additional combustion product distribution calculations as requested by this Laboratory. The final report was reviewed and returned to the contractor in August 1990. Copies of the final report are due to this Laboratory by 7 October 1990. This is the final Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5021 28 September 1990

TITLE: LP 1846 Liquid Gun Propellant Dermal Toxicity Study in Male Miniature Hanford Swine

PROPONENT COMMAND(S): U.S. Army Ballistic Research Laboratory

APC: CONTRACT: 89PP9944 WORK UNIT: 018

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: National Center for Toxicological Research, Jefferson, AR

PI: Witt, William COR: Palmer, Winifred G.

OBJECTIVES: Liquid gun propellant LP 1846 will be applied to the skin of Hanford miniature swine to determine the no observable adverse effect level (NOAEL), the effect of rinsing after application, and the effect of application on a fabric patch.

APPROACH: Hanford miniature swine will be treated once with the liquid gun propellant LP 1846 by the dermal route of exposure. Phase I studies will determine the NOAEL and kinetics for methemoglobin formation. Phase II studies will compare the effects of direct dermal and fabric patch exposure to LP 1846. Phase III studies will examine the impact of removal of LP 1846 from the skin (by washing) on the propellant's toxic effects. Skin toxicity will be assessed in all the phases.

PROGRESS: Phase 1 of this study, with six animals per dose, is currently in progress. Animals are being treated with undiluted LP1846 on 0, 1, 5, 10, and 15 percent of their body surface. Methemoglobin levels are unchanged with 1 percent LP1846 and increase positively with the higher doses. Methemoglobin levels tend to peak later in high-dose animals. The proposed positive control, ammonium nitrate, caused no changes in methemoglobin levels and had negligible effects on the skin. To maximize the information derived from Phase 1, ammonium nitrate treatment was discontinued after the second replicate and replaced with 1 percent LP1846.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5025 28 September 1990

TITLE: Review of Reactions of Biotoxins in Water (CBIAC Task 152)

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: MIPR90MM0530 WORK UNIT: 176

RAD: I TYPE OF FUNDING: 6.2 PROJ/TASK: 878CA

REQUIREMENTS DOCUMENT: Memorandum, USABRDL, 6 Jul 87, subject: Requirement for Medical Research in Field Water, with 1st End, HQDA (DASG-PSP-E), 24 Jul 87

LOCATION: Battelle Memorial Institute, Columbus, OH

PI: Warner, J.S. COR: Burrows, W. Dickinson

OBJECTIVES: Reactions of biotoxins in natural water, which may be exposed to sunlight and/or disinfectants, in order to assess the hazard to personnel consuming water contaminated with products of biotoxins in the environment will be reviewed.

APPROACH: Computer-assisted literature search for relevant data on selected protein neurotoxins (Botulinum toxin A, Tetanus toxin, Diphtheria toxin, Ricin) and nonprotein neurotoxins (Palytoxin, Tetrodotoxin, Saxitoxin, Conotoxin, Microcystin, Anatoxin A) with special attention to rates, mechanisms, and products of reactions of these materials when present in water at trace levels will be performed. The classified literature also will be reviewed, insofar as practical.

PROGRESS: A computerized search of the literature covering the 10 biotoxins of concern is complete. Limited useful data were recovered for all but conotoxin. The final report entitled "Review of Reactions of Biotoxins in Water," by J.S. Warner, has been scientifically approved and sent to the Defense Technical Information Center. This is the final Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5026 28 September 1990

TITLE: Utilization of Neurophysiological Protocols to Characterize Soldier Response to Irritant Gases

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-89-C-9136 WORK UNIT: 170

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Northeast Research Institute, Farmington, CT

PI: Einhorn, Irving N. COR: Eaton, James C.

OBJECTIVES: The study will determine the feasibility of a protocol that combines neurophysiology, bioassays, and behavioral tests for the assessment of a decrement of performance produced by respiratory irritants present in the exhaust emissions from guns and rockets. Neurophysiological measurements will be determined for use in assessing the early decrements of performance developed as a consequence of exposure to the respiratory irritant hydrogen chloride (HCl).

APPROACH: Develop a battery of neurophysiological measurements including electroencephalogram (EEG) activity, electromyogram activity, visual evoked response, and somatosensory evoked response in development of a protocol to quantify the response of rats to exposure to the respiratory irritant HCl. Measure changes in animal performance and homeostasis using parallel bioassay procedures, exposing the rats to various concentrations of HCl encountered in weapons system exhaust.

PROGRESS: All of the experimental work has been completed; and the final report, "Utilization of Neurophysiological Protocols to Characterize Soldier Response to Irritant Gases," has been received and accepted. The brainstem auditory evoked response was shown to be the most sensitive to the effects of exposure to HCl of the neurophysiological measurements tested. Statistically significant changes were also observed in the EEG results. These changes were observed prior to any indication of changes in animal homeostasis, determined by monitoring blood parameters, in time periods much earlier than would be required to observe significant behavioral changes. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5027 28 September 1990

TITLE: Characterizing Soldier Responses to Irritant Gases

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-89-C-9135 WORK UNIT: 172

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, HQDA (DASG-PSP), 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Essex Corporation, Orlando, FL

PI: Kennedy, Robert S. COR: Eaton, James C.

OBJECTIVES: The study will develop an optimized test battery sensitive to performance impairment caused by: agents, such as chemical intoxicants; conditions, such as thermal extremes, noise, and sensory deprivation; and processes, such as aging, sleep deprivation, and emotional strain.

APPROACH: A quantitative model of performance degradation will be formulated, indexing agents will be selected, literature on animal and human models will be reviewed, a menu of tests relevant to military jobs will be selected, and the tests will be administered to a population of human subjects.

PROGRESS: All of the experimental work has been completed; and the final report, "Characterizing Soldier Responses to Irritant Gases," has been received and accepted. Two primary tasks were completed: description of the relation between an automated performance test system (APTS) and the Armed Services Vocational Aptitude Battery (AVSAB), and collection and analysis of alcohol dose equivalency data under tightly controlled experimental conditions. Regression equations were created to translate reductions in APTS performance into equivalent AVSAB performance. This is the last Semiannual Summary Information Paper for this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5028 28 September 1990

TITLE: Development of a Bench-top Industrial Hygiene Test Chamber

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-90-C-0077 WORK UNIT: 205

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Department of Defense FY90 Small Business Innovation Research (SBIR) Program

LOCATION: Northeast Research Institute, Farmington, CT

PI: Einhorn, Irving N. COR: Young, John Y.

OBJECTIVES: The objective is to design and build an air-tight bench-top test chamber for generating a known built-up concentration and air dilution under controlled conditions for testing of aerosols particulates, gases, and vapors.

APPROACH: The design and construction of the chamber will take into consideration the complex calculation of the dynamic concentrations, the amount of test substance to be introduced, and the resultant airborne concentration in the chamber of a given dimension. Automation is the choice approach to simplify the process. Equipment selected for this project needs to be tested for calibration and applicability for the chamber. The design will allow the user to follow a simple set of instructions to determine the amount of test substances needed, the rate of generation, and the rate of air flow to achieve the desired dilution concentration in the chamber. The substance generation and the air flow rates can be selected by adjusting the control mechanisms equipped with the chamber. The chamber needs to be constructed of steel frame for sturdiness, of rubber seals to ensure air tightness, and of plexiglas for viewing, and with access door for testing equipment and for cleaning. The test chamber needs to be field tested for a variety of industrial hygiene equipment, and the accuracy and reliability must be proved and documented. Sample loss on the walls and interior surfaces of containers is common, and certain substances must be tested for such loss. The amount of loss can be programmed into the automated dynamic dilution control to afford better accuracy and reproducibility of the desired results.

PROGRESS: A test chamber made with polyetherimide that is strengthened with plexiglas and Swagelok fixtures was built. A computerized gas generator system was connected to the chamber and four gases had been tested. Gases that were tested included carbon monoxide, hydrogen chloride, carbon dioxide, and ammonia. Reliability and reproducibility of the generator performance were confirmed. The contractor is currently writing the initial operator's manual and the Phase I final report.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5029 28 September 1990

TITLE: Spiral Wound Ion Exchange Unit for the Production of Sterile Water for Injection

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-90-C-0085 WORK UNIT: 203

RAD: II TYPE OF FUNDING: PROJ/TASK:

REQUIREMENTS DOCUMENT: Memorandum, USAMRDC, SGRD-PLB, 21 Apr 88, subject: IV Fluidmaker

LOCATION: Foster-Miller, Inc., Waltham, MA

PI: Gold, Harris COR: Burrows, W. Dickinson

OBJECTIVES: The objective is to devise a small, disposable ion exchange element suitable for use with the IV Fluidmaker.

APPROACH: The device in question must be no larger than a 12 ounce beverage can, must have an exchange capacity of at l . t 1 gram as sodium chloride, must produce water with a specific resistance of at least 1 megohm, and must be operable in any position (i.e., horizontal or vertical) without loss of exchange capacity (i.e., without excess channeling). The innovative aspect of this project involves placing the resin in a flexible spiral coil under pressure so that open channels cannot develop.

PROGRESS: A preprototype device has been developed and tested. Basic requirements have been met. The draft final report is due in October 1990.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5030 28 September 1990

TITLE: Conductance Biosensor for Detecting Microorganisms

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-90-C-0079 WORK UNIT: 206

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Letter, HSHA-CDM, 16 Dec 88, subject: Draft Operational and Organizational Plan (O&O) for a Family of Medical Water Quality Monitoring Equipment (FMWQME)

LOCATION: Bio-Metric Systems, Inc, Eden Prarie, MN

PI: Swanson, Melvin J COR: Schaub, Stephen A

OBJECTIVES: Develop innovative method for a rapid field water microbiology test kit using conductance biosensor technology which will determine water quality in near real time. The technology will be developed to fit within the guidelines of the O&O plan for a FMWQME.

APPROACH: The project will demonstrate the feasibility of conductance biosensor technology for detecting microorganisms in water by measuring changes in conductance across microporous polycarbonate membranes coated with specific antibodies; the membranes will be coated with hydrophilic polymers using photochemical coupling. Antibodies specific for E. coli are then immobilized onto the polymer-coated membranes, primarily in the pores. The coating and immobilization methods are designed to minimize nonspecific adsorption of proteins and to stabilize the antibody. The technique is first being developed to detect E. coli in water samples.

PROGRESS: A number of photochemically activated polymers have been coupled onto membrane surfaces and antibodies specific to E. coli have been experimentally immobilized onto the polymers in an orientation that will allow the antibodies to react with specific antigens. The specific activity of the antibody adsorption processes have been defined. Studies are being conducted on the best polymer-antibody complexes, to determine their affinity for E. coli. Determinations of the measurability of changes in electric conductance on the membranes in response to antibody contact with the microorganisms are being made.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5031 28 September 1990

TITLE: Mixed-Bed, Ion Exchange Device for Water Purification

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-90-C-0090 WORK UNIT: 204

RAD: II TYPE OF FUNDING: 6.1 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Memorandum, USAMRDC, SGRD-PLB, 21 Apr 88, subject: IV Fluidmaker

LOCATION: Sepratech, Carlsbad, CA

PI: Taylor, Michael A. COR: Burrows, W. Dickinson

OBJECTIVES: The objective is to devise a small, disposable ion exchange element suitable for use with the IV Fluidmaker.

APPROACH: The device in question must be no larger than a 12 ounce beverage can, must have an exchange capacity of at least 1 gram as sodium chloride, must produce water with a specific resistance of at least 1 megohm, and must be operable in any position (i.e., horizontal or vertical) without loss of exchange capacity (i.e., without excess channeling). The innovative aspect of this project involves adapting a proprietary device which eliminates channeling by control of flow pathways.

PROGRESS: A preprototype device has been developed and tested. Basic requirements have been met. The draft final report is due in October 1990.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5032 28 September 1990

TITLE: Small Ion Exchange Water Purifier

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: DAMD17-90-C-0088 WORK UNIT: 208

RAD: II TYPE OF FUNDING: 6.1 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Memorandum, USAMRDC, SGRD-PLB, 21 Apr 88, subject: IV Fluidmaker

LOCATION: Ecotech, Elk Grove, CA

PI: McGehee, Donald C. COR: Burrows, W. Dickinson

OBJECTIVES: The objective is to devise a small, disposable ion exchange element suitable for use with the IV Fluidmaker

APPROACH: The device in question must be no larger than a 12 ounce beverage can, must have an exchange capacity of at least 1 gram as sodium chloride, must produce water with a specific resistance of at least 1 megohm, and must be operable in any position (i.e., horizontal or vertical) without loss of exchange capacity (i.e., without excess channeling). The innovative aspect of this project involves securing the ion exchange resin in hydrophilic foam to eliminate channeling. The water undergoing treatment will travel a serpentine path.

PROGRESS: A preprototype device has been developed and tested. Basic requirements have been met. The draft final report is due in October 1990.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

OCCUPATIONAL HEALTH RESEARCH BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: OHRE-5033 28 September 1990

TITLE: Microencapsulation/Passive Dosimeter Development

PROPONENT COMMAND(S):

APC: CONTRACT: DAMD17-90-C-0091 WORK UNIT: 207

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: 802BA

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, with 1st End, OTSG, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Polytronix, Inc., Richardson, TX

PI: Lin, Jacob W. COR: Steven H. Hoke

OBJECTIVES: The objective is to develop a passive dosimeter badge for atmospheric HCl using the technique of microencapsulation.

APPROACH: Various combinations of pH sensitive dyes and buffers will be applied to various substrates and evaluated for their sensitivity to the presence of hydrogen chloride in the air. The dyes which demonstrate favorable response characteristics will be microencapsulated and incorporated into a badge which will be worn as a personal dosimeter. These badges will be tested for response to peak concentrations of HCl as well as real-time response.

PROGRESS: Over the course of the contract, the following pH sensitive dyes were evaluated: bromothymol blue; bromophenol blue; bromcresol green; bromcresol purple; congo red; methyl green; crystal violet; alizarin red S; and 2-(2,4-dinitrophenolazo)-1-naphthol-3,6-disulfonic acid disodium salt. Each of the dyes were tested with each of three methods of preparation. The first method used the direct adsorption of the dye onto silica gel. The second approach was to dissolve the indicator dye in a polyvinyl alcohol solution and cast the mixture as a thin film. The third approach was to adsorb the indicator dye onto the surface of thin film chromatography strips using a solvent evaporation procedure. The indicator dye/substrate combinations that exhibited response to HCl gas were sent to USABRDL for evaluation at low concentrations using the toxic gas dilution system. A few of the dyes started to change color at about 50 mg/m^3. Two of the dye/substrates changed color at about 400-550 mg/m^3. Several of the dye/substrates did not exhibit any response at the 1400 mg/m^3 level. However, none of the dye/substrate combinations exhibited any response under 20 mg/m^3, which is near the TLV of 7 mg/m^3.

THIS PAGE INTENTIONALLY LEFT BLANK.

RESEARCH METHODS BRANCH

In coming years, the Army will spend billions of dollars to clean up contaminated water and wastewater. Because of the magnitude of this cost, it is essential that remediation efforts at Army sites be based on sound assessments of potential toxicity. Mammalian toxicity information is often lacking for military-unique contaminants; and where data are available, the presence of complex mixtures of chemicals makes toxicity extrapolations difficult. Furthermore, a complete toxicity testing profile for an individual chemical can cost millions of dollars and take several years to complete.

To help resolve these toxicological testing problems, the Research Methods Branch is developing and applying new, nonmammalian biomonitoring assessment techniques that are faster and less expensive than presently available methods. When validated, these techniques can be used at great cost savings in laboratory tests of new Army chemicals, such as munitions and smokes, as well as for on-site toxicity evaluations of hazardous waste sites and wastewater effluents. Procedures that integrate environmental and occupational effects of complex chemical mixtures in a constantly changing environment are critical to assessing military environmental and occupational health problems.

Carcinogenicity. Chemical carcinogenicity testing can take 3-4 years to complete and can cost over a million dollars per chemical using rodents. These tests cannot be performed in field locations. USABRDL is investigating nonmammalian species for carcinogenicity assessment. Studies have shown that fish are highly sensitive to many chemicals that are carcinogenic to mammals. Joint research projects are under way with U.S. Environmental Protection Agency and National Cancer Institute. Nonmammalian carcinogenicity assessment techniques offer the ability to do large-scale bioassays and directly assess complex environmental mixtures.

Basic research involved characterization of the histopathology, ultrastructure, and molecular alterations of chemically induced neoplastic changes in livers of fish. This information will be used to evaluate potential for interspecies extrapolation of data among fish, rodents, and man.

The role of oncogenes in development of neoplasia in fish was investigated in collaboration with Duke University Marine Laboratory. Deoxyribonucleic acid from a fish neoplasm was successfully transfected into athymic mice. Subsequent production of aggressive lesions in mice suggests potent genetic transforming capacity from chemical induced fish neoplasms. Current research is focused on isolating and characterizing possible oncogenes from these tissues, with the future aim of providing a short-term test for determining oncogenic potential of contaminated environmental samples.

Pathological and biochemical responses of fish exposed to several classes of known mammalian carcinogens and noncarcinogens were explored. Initial results show the medaka responds similarly to rodents following exposure to chemical carcinogens, including acetylaminofluorene, dimethylbenzanthracene,

and ethylene dibromide. Research is continuing with additional chemicals and will aid in interpretation and eventual use of these relatively inexpensive, nonmammalian carcinogenicity bioassays.

Developmental Toxicity. Another test procedure requiring significantly less time and expense than its mammalian counterpart is a developmental toxicity assay with an amphibian species. This 96-hour test is a predictor of whether water-borne chemicals could cause developmental toxicity in mammals. As with the carcinogenicity tests, it is being adapted for water monitoring at Army hazardous waste sites.

A rat liver fraction was prepared for use with the amphibian developmental toxicity tests. This will improve accuracy of the test system for detecting those chemicals that require in vivo metabolic activation from a proteratogen to an active teratogen. The amphibian developmental toxicity test was adapted for use in an on-site biomonitoring facility, thus allowing direct testing of contaminated water and wastewater at Army sites.

Immunotoxicity. Increasing attention is being focused on environmental chemicals that damage or suppress the immune system. Research is determining whether nonmammalian species can be used to screen environmental samples for immunotoxicity. Tests are being conducted with the same aquatic species used for carcinogenicity assessment.

Acute Toxicity. Field tests are under way with an automated fish biomonitoring system that detects presence of acutely toxic contaminants in water or wastewater. Potential applications include continuous monitoring of effluents discharged from Army wastewater treatment plants and monitoring of water supplied to Army water treatment facilities. This system will be very useful in early detection of leaks of toxic materials or in detecting potentially dangerous chemicals in raw drinking water supplies.

A statistical program capable of distinguishing normal and abnormal fish ventilatory and movement responses was incorporated into the automated biomonitoring system. This development will allow rapid response by computers to toxic conditions developing in water effluents. The computerized system will provide timely information on presence of toxic materials in water or wastewater at Army sites. Research was initiated to determine response time and sensitivity of the monitoring system to a range of chemicals representing different modes of toxicity.

Aquatic Ecosystem Effects. USABRDL is participating in development of an aquatic microcosm test system as a sensitive indicator of ecological effects. Unlike single-species aquatic toxicity tests, the microcosm test indicates ecosystem-level effects such as interspecies interactions and multiple species effects. Validated microcosm tests will provide a useful, relatively accurate and inexpensive method for evaluating potential ecosystem effects of new Army chemicals or waste materials.

Tests evaluating interlaboratory reproducibility of aquatic microcosm tests were completed, and a manuscript is in preparation. Compounds tested include copper and TNT. When validated, the microcosm test will provide a useful, accurate and relatively inexpensive method for evaluating potential ecosystem effects of new Army chemicals or waste materials.

The first phase of research was completed on development of an automated monitoring system for aquatic microcosms. This system evaluates changes in microcosm system productivity by monitoring microcosm-induced pH changes in test chambers. It will be compatible with the automated system used in the biomonitoring trailer now being developed by USABRDL and will reduce time required for environmental assessments.

On-Site Biomonitoring. USABRDL is transitioning the forementioned methods to the field to address Army-relevant problems. A mobile biomonitoring trailer designed by USABRDL staff was installed at Aberdeen Proving Ground, MD, and utilized to monitor toxicity of a wastewater effluent. Additional sites being considered for biomonitoring are O'Field and Beachpoint (both at Aberdeen Proving Ground and a site at Rocky Mountain Arsenal, CO. This facility contains several nonmammalian test systems described above, including the automated biological monitoring system. A second biomonitoring trailer was installed at Fort Detrick, MD, to test contaminated groundwater and to aid in developing new methods. This approach will provide previously unavailable information on potential health and ecological effects of contaminated waters at Army sites.

THIS PAGE INTENTIONALLY LEFT BLANK.

INFORMATION PAPERS FOR PROJECTS ACTIVE IN FY90
RESEARCH METHODS BRANCH

THIS PAGE INTENTIONALLY LEFT BLANK.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBI-0001 28 September 1990

TITLE: Carcinogenicity Model Research

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F215 CONTRACT: WORK UNIT: 005

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS04

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Gardner, Henry S., Jr. COR:

OBJECTIVES: The objective of this research is to provide new, nonmammalian carcinogenicity assessment techniques for use in both environmental and occupational areas.

APPROACH: The use of nonmammalian, in vivo models for carcinogenicity assessment is receiving much attention. In vitro assays are also being explored. Various cooperative biochemistry, pathology, and molecular biology tasks are being pursued to provide the information needed for cross-species extrapolation of bioassay results. Research into the use of these techniques for on-site applications is a focus of the program.

PROGRESS: An assessment of groundwater at Fort Detrick has been accomplished and is currently being followed up focusing on both whole animal histopathology and molecular alterations of nucleic acids. Early findings were that no response was observed in uninitiated animals. Animals which had been initiated with a low concentration of diethylnitrosamine demonstrated a groundwater concentration-dependent tumor response suggestive of a promotional role being played by the contaminants in the groundwater. In addition, the on-site application of trailer-housed cancer bioassays is being pursued at Aberdeen Proving Ground. Initial discussions have been held with staff members at Rocky Mountain Arsenal regarding possible applications at this Army site as well.

2nd QUARTERLY SUMMARY INFORMATION PAPER, FY89

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBI-0002 30 March 1990

TITLE: Biochemical Toxicology

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F211 CONTRACT: WORK UNIT: BS04

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: S04

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Rosencrance, Alan B. COR:

OBJECTIVES: The objective is to investigate the metobolic path of military specific compounds in fish liver, blood and gills by gas chromatography and clarify the nature of the enzymes responsible for the oxidation of these compounds. These data will be used in the development and validation of novel toxicity assessment methods and in cross-species extrapolation.

APPROACH: Literature data bases will be searched for pertinent studies dealing with appropriate analytical techniques, and these techniques will be used in studies of the metabolic pathway of trichloroethylene (TCE) or diethylnitrosoamine (DEN). After fish have been exposed to these compounds, their liver, blood and gills will be removed and analyzed for DEN or TCE metabolites and species-specific enzymatic activity.

PROGRESS: In an initial study, medaka were exposed to TCE and their tissues were subsequently analyzed for TCE and metabolites. TCE was detected in the tissues but no metabolites were found. Additional studies are not planned for this project area due to the heavy analytical chemistry workload required to support other projects within the Health Effects Research Division.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBI-0003 28 September 1990

TITLE: Developmental Toxicity Test Model Research

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F410 CONTRACT: WORK UNIT: 006

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS15

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, With 1st End, HQDA, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Finch, Robert A. COR:

OBJECTIVES: The objective is to improve the predictive capability of developmental toxicity screening tests for use by the Army for toxicity assessment of chemical compounds with military relevance.

APPROACH: Accurate, shorter-term and more economical nonmammalian developmental toxicity test models will be developed and validated. Initial focus will be on the development of the Xenopus frog embryo developmental toxicity test model.

PROGRESS: Validation of the Frog Embryo Teratogenicity Assay - Xenopus (FETAX) is continuing. Base-line control data have been collected on the rate of mortality, developmental abnormalities, and growth of Xenopus frog embryos under standard in-house test conditions. Nitroguanidine, an Army munition compound with available mammalian teratology data, has been tested in the FETAX system and the data are being analyzed. Additional Army-unique chemicals with available mammalian teratology data will be tested.

Application of the FETAX system to the mobile biomonitoring laboratory is in progress. Modifications have been made to the exposure vessels to allow for better circulation of test effluent around the Xenopus frog embryos. Data are being analyzed from a preliminary run of the FETAX system on undiluted and 10 percent (V/V) concentration of effluent from the wastewater treatment plant at Aberdeen Proving Ground. Additional runs of the FETAX system on environmental samples from the new biomonitoring site at Aberdeen Proving Ground are planned.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBI-0004 28 September 1990

TITLE: In Vitro Toxicity Test Model Research

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: F411 CONTRACT: WORK UNIT: 007

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS15

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, With 1st End, HQDA, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Finch, Robert A. COR:

OBJECTIVES: The objective is to improve the predictive capability of in vitro toxicity screening tests for use by the Army for toxicity assessment of chemical compounds with military relevance.

APPROACH: To develop and validate accurate, short-term, and more economical in vitro toxicity test models. Initial focus will be on the development of in vitro hepatocyte test models and on in vitro systems for assessing eye irritation.

PROGRESS: Validation of the Eytex in vitro eye irritation assay has been completed. The testing of several Army munition compounds in the Eytex assay has been completed and the data are being reviewed and analyzed. Comparison of the Eytex results with those from the Draize rabbit eye irritation studies on the same munition compounds is in progress. Review of preliminary data indicates good correlation between the results of these two assay systems. In vitro primary cultures of medaka fish liver hepatocytes have been initiated. Initial results show that the medaka hepatocytes can be maintained in flask cultures for at least 2 weeks. Initial optimization of culture conditions and characterization of the hepatocytes with respect to their retention of differentiated structures and functions have been completed. Scanning and transmission electron microscopic studies have been completed in order to characterize changes in the hepatocyte ultrastructure relative to time in culture. Preliminary studies to characterize enzyme activities in the hepatocytes after various times in culture have been completed. The results of the work on the medaka hepatocytes were presented at the Tissue Culture Association meeting in June 1990. A manuscript for journal publication is planned.

SEIMANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBI-0005 28 September 1990

TITLE: Development of an Aquatic Toxicity Biomonitoring System

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F216 CONTRACT: WORK UNIT: 003

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS04

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Shedd, Tommy R. COR:

OBJECTIVES: The objective is to develop and field test an automated toxicity monitoring system to continuously monitor water or wastewater at Army facilities or contaminated waste sites.

APPROACH: An operational prototype of the automated toxicity monitoring system will be completed following final modifications in hardware and software and the incorporation of a statistical package to determine the presence of abnormal fish ventilatory patterns caused by toxic materials in the water. The response time and sensitivity of the system to selected toxicants will be determined. The biomonitor will be installed in a mobile trailer and field tested at a Department of Defense site.

PROGRESS: Single compound testing has been conducted with pentachlorophenol, phenol, MS-222, and malathion. The data have been analyzed to establish the time to response of the ventilatory monitoring system to acutely toxic concentrations of these materials. The computer program has been adjusted to maximize the sensitivity of the system to toxicant response while minimizing the occurrence of "false alarms" in the control fish. Statistical analysis of the data has now been incorporated into the biomonitoring system program, allowing real-time response to developing toxic conditions. A total of four field tests have been conducted using the ventilatory monitoring system in the biomonitoring trailer at Aberdeen Proving Ground (Edgewood area). The trailer was moved to Aberdeen Proving Ground (main post) and one ventilatory monitoring test was run and is being analyzed. Extensive data records have been compiled and are being analyzed to allow computation of the accuracy of the computer in monitoring ventilatory rate and depth, cough rate, and movement.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBI-0006 28 September 1990

TITLE: Aquatic Microcosm Development

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F217 CONTRACT: WORK UNIT: 002

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS04

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Tommy R. Shedd COR:

OBJECTIVES: The objective is to develop a simple, sensitive method for monitoring the effects of Army-relevant materials on aquatic ecosystems that will represent a substantial improvement over present single species methods of toxicity evaluation. A second objective is to explore the possibility of automating the system response and incorporating the microcosm into a mobile biomonitoring facility that can be used for on-site toxicity evaluations at Army sites.

APPROACH: The sensitivity and repeatability of an existing aquatic protozoan microcosm test will be evaluated in pure compound testing. Responses of the protozoan microcosm to the toxicants will be compared with those of traditional single species toxicity tests and available field exposure tests. An automated version of the microcosm, featuring continuous monitoring of pH and dissolved oxygen conditions, will be developed and tested.

PROGRESS: Microcosm tests with copper and 2,4,6-trinitrotoluene (TNT) have been completed to evaluate the sensitivity of the present set of test end points and to facilitate comparisons with similar studies done under contract at another laboratory. Algal (diatom) species diversity was evaluated in the copper test by specialists at Pennsylvania State University. Significant reductions in species numbers were noted at copper concentrations as low as 10 micrograms per liter. These results were in accordance with the non-taxonomic effect parameters monitored. The TNT test was repeated due to a diluter malfunction in the first test. The second test has been completed and the data demonstrated no significant response of the microcosm at the highest concentration of TNT tested. The variability between replicates may be reducing the response of the microcosm to toxicants. A test has been completed looking at different substrate shapes to decrease variability and the date are being analyzed.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBI-0007 28 September 1990

TITLE: Application of On-Site Toxicity Assessment Techniques

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F219 CONTRACT: WORK UNIT: 008

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS04

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Tommy R. Shedd COR:

OBJECTIVES: The objective of this research will be to incorporate new, non-mammalian health and environmental toxicity assessment techniques into an overall testing scheme that can be systematically applied for hazard assessments at Army facilities having contaminated soil or water.

APPROACH: Existing methodologies for assessing potential toxic effects at hazardous waste sites or the toxicity of the byproducts of waste treatment processes will be reviewed. New assessment methods, including the utilization of an on-site biomonitoring facilities, will be proposed that incorporate new toxicity test methods. The proposed assessment methods will be field tested and the results discussed relative to presently available hazard assessment techniques.

PROGRESS: We are presently working on developing a written protocol for the fish ventilatory acute toxicity monitoring system. Initial versions of other test protocols developed for use in the biomonitoring trailer are being prepared in conjunction with the on-site contractor at Aberdeen Proving Ground (APG). Draft test protocols for conducting terrestrial toxicity testing (seed germination, earthworm toxicity, and frog embryo toxicity) have been received from the U.S. Environmental Protection Agency Environmental Research Laboratory in Corvallis, Oregon. Effluent testing at the APG Edgewood Area sewage treatment plant has been completed. The biomonitoring trailer has been moved to the Aberdeen Proving Ground (main post) sewage treatment plant for effluent monitoring. Water chemistry and a series of standard acute toxicity tests were run and the results show the effluent not to be acutely toxic. A fish carcinogenicity monitoring study using medaka is on-going. One field test with the fish ventilatory monitoring system has been run and is now being analyzed back in the Lab.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBI-0008 28 September 1990

TITLE: Development of Rapid, Inexpensive Acute Toxicity Test Methods

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F218 CONTRACT: WORK UNIT: 009

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS04

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Army Biomedical Research and Development Laboratory

PI: Shedd, Tommy R. COR:

OBJECTIVES: The objective of this research is to develop and validate a rapid, inexpensive toxicity test for screening environmental samples from Army hazardous waste sites.

APPROACH: Candidate fish species for use in the toxicity screening test will be selected from the killifish family, based on criteria including ready availability, ease of obtaining large numbers of resting eggs, lack of deterioration of the resting eggs over long periods of storage, and rapidity of hatching of the resting eggs when fish are requried for testing. Once one or more fish species have been chosen, a toxicity testing protocol will be developed emphasizing the need for simplicity and rapid attainment of results. The selected test species will then be screened for sensitivity to a variety of chemicals representing different modes of toxic action. Environmental samples from hazardous waste sites may also be included in the screening process.

PROGRESS: Eggs of the killifish Cynolebias nigropinnis have been received stored in moist peat moss. Initial hatching tests were successful, but additional work is required to develop a diet suitable for sustaining the newly-hatched fry. Newly-hatched rotifers have been used, but fry raised on these rotifers failed to survive although they were observed to consume large numbers of the rotifers. Preliminary tests investigating storage and subsequent hatching of refrigerated medaka embryos were unsuccessful. A commercial source has been identified for the embryos of the killifish Nothobranchius guentheri which will allow large numbers of embryos to be obtained at specific developmental stages. Minimum storage time for maintaining viable embryos is 3 months at 20 degrees Celsius. A toxicity testing protocol has been developed and testing with single compounds has been initiated.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5001 28 September 1990

TITLE: Studies on the Etiology of Neoplasia in Poikilothermic, Aquatic Animals: Finfish and Shellfish

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88PP6822 WORK UNIT: 296

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: National Cancer Institute, Bethesda, MD

PI: Longfellow, David G. COR: Gardner, Henry S., Jr.

OBJECTIVES: This research will provide insight into the neoplastic process in nonmammalian animals. The new, nonmammalian carcinogenicity assessment techniques are for use in both environmental and occupational applications.

APPROACH: The investigators will study the effects of various carcinogens on the development of neoplasia, and metabolic pathways will be determined. Studies will be conducted on deoxyribonucleic acid (DNA) repair and adduct formation, and the role of oncogenes in the neoplastic process in trout will be investigated.

PROGRESS: The carcinogenicity of the polynuclear aromatic hydrocarbon 7,12-dimethylbenz(a)-anthracene (DMBA) was demonstrated in rainbow trout. The role of dietary contaminants in enhancing or inhibiting carcinogenicity was also explored. The most siginificant effect was caused by polychlorinated biphenyls, which, when given along with DMBA, significantly increased the tumor incidence over the tumor levels expected from either chemical by itself. Additional studies of the uptake, metabolism, and DNA-binding of DMBA were conducted. DMBA was apparently conjugated with glucuronides by the trout embryos, but not with sulfate conjugates. Major metabolites were identified and the time-course of their formation was determined. Significant DNA adducts were found after 24 hours of exposure of embryos to DMBA. Other studies investigated the relationships between the metabolism of a carcinogen (aflatoxin B1, AFB1), DNA-binding, target cells, cytotoxicity, regeneration, and carcinogenicity. Results suggested that the cytotoxicity of AFB1 contributes to but is not required for carcinogenicity. In addition, autoradiography was used to demonstrate that presumptive oval cells in the liver are apparently responsible for liver regeneration following exposure to acutely toxic levels of AFB1. Portions of a trout oncogene have been isolated and sequenced. These segments are 80 to 90 percent homologous with mammalian H-ras oncogenes. Research papers are completed and are being forwarded and the project is completed.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5002 28 September 1990

TITLE: Assessment of DNA Modifications in Medaka (O. latipes) Exposed to Chemicals in Contaminated Ground Water

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88Z8043 WORK UNIT: 001

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Pacific Northwest Research Laboratories, Seattle, WA

PI: Malins, Donald C. COR: Gardner, Henry S., Jr.

OBJECTIVES: This research project will assist in identifying low molecular weight alterations in nucleic acids caused by xenobiotic chemicals. This technique should be useful in the characterization of exposure of experimental animals to free radical forming chemicals which have significance in carcinogenicity and toxicity. Test procedures developed will be applied to the evaluation of contaminated ground water at Army sites.

APPROACH: Animals will be exposed to environmental media by the Lab personnel. These exposures will take place in Army-relevant environmental settings. Animals will be analyzed by the principal investigator and staff for changes in nucleic acid composition. These findings will be compared with the incidence of neoplasia in other animals similarly exposed.

PROGRESS: Analytical techniques have been developed for assessing free radical-induced damage in deoxyribonucleic acid (DNA) of the medaka. Nucleotide bases are derivatized, then analyzed for evidence of nucleotide base oxidations using gas chromatography coupled with mass spectrometry and single ion monitoring. Approximately 200 micrograms of medaka DNA is required for the analysis. Identification efforts are being focused on certain nucleotide derivatives that are produced as a result of DNA exposure to free radicals, such as 2,6-diamino-4-hydroxy-5-formamidopyrimidine (FAPY). Preliminary range finding results from medaka exposed to trichloroethylene indicate a ~200 fold increase in FAPY guanine. Results using tumor tissue from feral fish indicate that this endpoint may be extremely sensitive and specific for neoplastic and preneoplastic tissue. These results have been published in Carcinogenesis. Future work will more exhaustively explore the effects of trichloroethylene and diethylnitrosamine exposures in medaka.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5003 28 September 1990

TITLE: Acute Exposure of Medaka to Carcinogens: An Ultrastructural, Cytochemical and Morphometric Analysis of Liver and Kidney

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 90C0025 WORK UNIT: 036

RAD: III TYPE OF FUNDING: 6.2, 6.3a PROJ/TASK: A835, DERA

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Southeastern Louisiana University, Hammond, LA

PI: Norton, William N. COR: Gardner, Henry S., Jr.

OBJECTIVES: This research will study the ultrastructural and enzyme cytochemical markers observed in medaka exposed to various carcinogens. These data will be useful in assessing the carcinogenic process in this model animal. The results will aid in validating the use of fish for determining the carcinogenicity of Army-relevant materials.

APPROACH: Animals will be exposed at the Lab to three different carcinogens and subsequently sent for analysis to the principal investigator (PI). Various ultra-structural enzyme markers as well as ultrastructural histopathology will be determined.

PROGRESS: Initial research has been accomplished characterizing the ultrastructural characteristics of medaka hepatocytes in vitro. This has included both scanning and transmission electron microscopy. The characteristics of various organelles (mitochondria, smooth and rough endoplasmic reticulum, nucleus) have been observed. Exposures have begun with medaka which will characterize the ultrastructural response to diethylnitrosamine and trichloroethylene both individually and in combination in the medaka.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5004 28 September 1990

TITLE: Development of an Aquatic Bioassay for Carcinogenicity and Toxicity Testing Using the Medaka as a Model

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88C8029 WORK UNIT: 012

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Johns Hopkins University, Baltimore, MD

PI: Bunton, Tracie E. COR: Finch, Robert A.

OBJECTIVES: This research will help to determine the validity of using fish as models for evaluating the carcinogenicity of Army-relevant materials. The specific objective is to characterize the cellular responses of fish to known hepatic carcinogens and to compare these responses to those of rodents and man.

APPROACH: Medaka (Oryzias latipes) will be exposed to known carcinogens and the development of neoplastic and preneoplastic changes in the liver will be characterized using a variety of techniques. Comparison will be made between lesions found in the medaka and those found in rodents and man.

PROGRESS: Research on the responses of the medaka to the carcinogen diethylnitrosamine (DEN) has been completed. A brief communication concerning the results of this work has been accepted for publication in Marine Environmental Research. A full report has been submitted to the Journal of the National Cancer Institute. One additional publication on ultrastructural changes in DEN-induced tumors has been submitted to Toxicologic Pathology. The evaluation of the normal structural and cellular development of the medaka liver from prehatching to 60 days post hatch has been completed. Fish samples have been processed for histology and transmission electron microscopy. The final project report has been received, reviewed, and accepted.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5005 28 September 1990

TITLE: Development of Carcinogenesis Bioassay Models: Response of Small Fish Species to Various Classes of Carcinogens

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88C8050 WORK UNIT: 010

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Gulf Coast Research Laboratory, Ocean Springs, MS

PI: Hawkins, William E. COR: Gardner, Henry S., Jr.

OBJECTIVES: The research is designed to determine the responsiveness of two small freshwater fish species to a variety of known mammalian carcinogens. The research will also characterize the metabolic pathways existing in these species with particular attention being paid to the hepatic mixed function oxidase system.

APPROACH: Two fish species (medaka, Oryzias latipes, and guppy, Poecilia reticulata) are exposed to chemicals representative of classes of mammalian carcinogens. Responses are compared with mammalian response and metabolic pathways are elucidated.

PROGRESS: Carcinogen exposures have been completed for 1,1,2,2,-tetrachloroethane (TeCE), cadmium (Cd) and 2-acetylaminoflourene (AAF). TeCE has been found to induce hepatocellular carcinoma in mice but not in rats. In this study, TeCE was not carcinogenic to either the medaka or the guppy. Cadmium has caused sarcomas at injection sites in rats and lung tumors in rodents when administered as an aerosol. Preliminary examination of cadmium-exposed medaka have not revealed any carcinogenic activity. Early analysis of fish exposed to the rodent carcinogen AAF has shown that AAF is weakly carcinogenic in the guppy but non-carcinogenic in the medaka. Biochemical studies with medaka and both AAF and 1,2-dibromoethane have been completed. AAF depresses hepatic microsomal oxidative enzyme activities in the medaka but increases glutathione S-transferase activity. Some production of the carcinogenic metabolic byproduct N-hydroxy-AAF was found in the in vitro metabolism studies. Medaka exposed to ethylene dibromide also showed increased glutathione S-transferase activity and depression of hepatic microsomal mixed function oxidase enzymes. Vinylidene chlorides have induced liver cancer in medaka and dibenzo(a,g)carbazole and methapyrilene exposures are continuing. Discussions regarding the selection of the final chemical compounds to be tested have focused on the use of known human carcinogens such as 4 aminobiphenyl.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5006 28 September 1990

TITLE: Fish as a Predictive Model for Epigenetic Carcinogens

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88C8051 WORK UNIT: 044

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: University of Massachusetts, Amherst, MA

PI: Calabrese, Edward J. COR: Gardner, Henry S., Jr.

OBJECTIVES: The research is designed to determine the responses of fish to potential epigenetic carcinogens. The research will provide information on the sensitivity of these species to these chemicals and aid in the application of the fish model to Army-unique applications.

APPROACH: Baseline beta-oxidation activity is determined for two fish species. Induction of activity via peroxisomal proliferation is then determined. Electron microscopic examination is also conducted to ascertain peroxisomal proliferation.

PROGRESS: Primary cultures of hepatocytes were established from rainbow trout and medaka for the short-term evaluation of epigenetic carcinogens by measuring peroxisome proliferation potential. Activation of cytochrome P-450 by acetaminophen was used as an indicator of retention of hepatocyte function for 72 hours in trout. Preliminary experiments with trout hepatocytes exposed to hypolipidemic drugs gemfibrozil, clofibric acid or ciprofibrate showed induction of peroxisomal beta-oxidation at 48 hours. Qualitative response of acyl-CoA oxidase activity correlated with the previous trout in vivo studies. Future research will characterize the enhancement of mitotic activity in exposed animals.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5007 28 September 1990

TITLE: Dietary Refinements in a Sensitive Fish Liver Tumor Model

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 90C0003 WORK UNIT: 002

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: University of California at Davis, Davis, CA

PI: Hinton, David COR: Finch, Robert A.

OBJECTIVES: The primary objective of this research is to develop a defined diet for a sensitive species of fish used in laboratory and on-site research on the carcinogenicity of potentially contaminated water and wastewater at Army facilities. A defined diet will enhance the repeatability of test results and will facilitate controlled studies on the effects of dietary factors on the carcinogenicity of Army-relevant materials.

APPROACH: A defined diet will be formulated and its capabilities for maintaining healthy populations of test fish will be compared with presently available foods. The relative levels of potential carcinogen-metabolizing enzyme systems in fish fed both food types will be compared, as will the incidence of tumors induced by two known carcinogens. Finally, the effects on carcinogenicity of dietary fatty acids will be determined using fish fed the defined diet, and the results will be compared with similar studies previously conducted with mammalian species.

PROGRESS: Range-finding studies have been conducted comparing an artificial diet for the medaka with diets of brine shrimp or commercially-available flake food. The artificial diet was far superior to the flake food diet in supporting the growth of medaka over a 13 week period. Growth of medaka fed the artificial diet initially lagged behind medaka fed brine shrimp, but the differences were slight after 13 weeks. A protocol has been received and approved for a definitive study that will compare the artificial diet with a diet including both live and commercially-available foods. The study will last 16 weeks, and is in progress. The study will monitor survival, growth, and reproduction.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5008 28 September 1990

TITLE: Biological (Molecular and Cellular) Markers of Toxicity

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88PP8861 WORK UNIT: 022

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN

PI: McCarthy, John F. COR: Gardner, Henry S., Jr.

OBJECTIVES: This project will determine the interactions of carcinogens with the nucleic acids of small fish species. These interactions will then be evaluated for use in risk assessment models in which the fish will be used as a sentinel organism. Potential applications include the toxicological evaluation of contaminated water at Army sites.

APPROACH: Medaka will be exposed to diethylnitrosamine (DEN), a potent hepatic carcinogen, and then observed for molecular and cellular indices of exposure. These changes will be incorporated into a risk assessment model to determine the utility of this species for human cancer risk assessment.

PROGRESS: Results of the high level DEN exposure have been summarized and presented in a paper in press. These results have been discussed in more detail in earlier information papers. In summary, the medaka exposed weekly for 4 weeks to high levels of diethylnitrosamine exhibited a depressed phase I enzyme activity (ethoxyresorufin O-deethylase, EROD) and enhanced phase II activity (gutathione S-transferase, GST). Future work will be determined by a reduced scope of work required by a budget shortfall. The principal investigator is rewriting the reduced scope of work based on available funds.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5009 28 September 1990

TITLE: New Methods for Toxicity Assessment

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88PP8857 WORK UNIT: 024

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Environmental Protection Agency, Office of Health and Environmental Assessment and Research and Development, Washington, DC

PI: Farland, William COR: Gardner, Henry S., Jr.

OBJECTIVES: This research project at the U.S. Environmental Protection Agency (USEPA) will define the utility of new carcinogenicity assessment models which are of interest to the Army and which are in development in the U.S. Environmental Protection Agency. These research efforts are of direct interest for use in the Laboratory's toxicity assessment program.

APPROACH: The medaka will be exposed to approximately 60 chemicals (47 mammalian carcinogens and 13 noncarcinogens) in a standard protocol to assess its responsiveness to various carcinogens. In other tests, very large numbers of fish will be exposed to low doses of known carcinogens.

PROGRESS: Exposures and subsequent histopathological assessment are continuing on the 60 chemicals selected for assessment with the protocol devised by the USEPA Duluth staff. This element of the USEPA program recently underwent an outside expert peer review. The results of this review will be made available to USABRDL. The empirical delivered dose work with diethylnitrosamine is continuing. Preliminary data with aniline seems to approximate the uptake model developed for rainbow trout. The low dose diethylnitrosamine experiment has begun with final protocol refinements being accomplished. The investigators have also pursued contacts at the National Center for Toxicological Research and the Chemical Industry Institute of Toxicology regarding internal dosimetry techniques to be employed in this experiment. Finally, support to the National Academy of Sciences Committee on Risk Assessment Methodology has been provided in conjunction with many other major federal participants.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5010 28 September 1990

TITLE: Immunotoxicological Assays Using the Japanese Medaka

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 8979016 WORK UNIT: 016

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: University of Maryland, Solomons, MD

PI: Anderson, Robert S. COR: Gardner, Henry S., Jr.

OBJECTIVES: This research project will investigate the immunological system of the medaka with respect to two major end points: (1) the impact of the medaka immune system on carcinogenicity in this species and (2) the possible use of medaka as a nonmammalian model system for human immunotoxicity assessment of new Army materials or contaminated environmental samples.

APPROACH: The research will determine the medaka's white blood cell counts as well as investigate both cellular and humoral indicators of immunocompetency. This will be accomplished by using the more readily available molluscan cell lines to determine the efficacy of macrophage cell-killing activity. These techniques will then be applied to medaka macrophages so that macrophage activity may be determined before and after exposure to known immunotoxins.

PROGRESS: The chemiluminescent (CL) response of medaka macrophages was shown to be quite sensitive to known chemical modulators of mammalian immune functions such as cadmium, lead, hydrocortisone and propyl gallate, as well as to the marine pollutant pentachlorophenol. The total 20-hour CL response, peak 20 hour induced CL response, and prestimulation (resting) CL after 20 hour exposure were all inhibited by these chemicals at various sublethal concentrations, in a dose-dependent manner. The 20 hour EC50 value with regard to total CL for these xenobiotics were calculated or estimated and compared to those recorded with female Swiss mice. Generally these values are similar for the macrophages from these two species, with the fish cells' CL response slightly less sensitive to cadmium considerably less sensitive to hydrocortisone, and slightly more sensitive to propyl gallate. The investigators will compare CL sensitivity to those of other immunoassays of medaka macrophage activity such as the reactive oxygen intermediate (ROI) tests, phagocytosis, and cell-mediated antimicrobial activity. They also plan to study the CL activity of medaka macrophages collected from fish exposed to immunomodulators in vivo.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5011 28 September 1990

TITLE: Further Development and Validation of the Frog Embryo Teratogenicity Assay-Xenopus (FETAX)

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88C8031 WORK UNIT: 042

RAD: III TYPE OF FUNDING: 6.1, 6.2 PROJ/TASK: BS04, A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 198?

LOCATION: Oklahoma State University, Stillwater, OK

PI: Bantle, John A. COR: Finch, Robert A.

OBJECTIVES: The objective is to further develop and validate the FETAX system, to develop an exogenous metabolic activation system suitable for use in the FETAX system, to identify suitable solvents for water-insoluble test chemicals, and to develop an atlas of abnormalities observed in FETAX.

APPROACH: The research conducted with the FETAX system will consist of two parts. The first part will attempt to develop a metabolic activation system for FETAX, while the second part will help determine whether FETAX can consistently identify human and mammalian developmental toxins. The metabolic activation system will utilize rat liver microsomes that have been metabolically stimulated with Arochlor 1254. By pretreating test chemicals with microsomal preparations, FETAX should be able to detect compounds which require metabolism to an active teratogenic form. Additional chemicals having known teratogenic properties will be tested in the FETAX system. Interlaboratory validation studies will be performed by several laboratories, including this Laboratory.

PROGRESS: Solvent interaction studies have been completed. Research is continuing on the development of the metabolic activation system and on the validation of the FETAX system. Several manuscripts have either been published, submitted for publication or are in preparation. The final draft of the Atlas of Abnormalities has been received and is being reviewed. Projected publication date of the Atlas is January-February 1991. Interlaboratory validation studies of FETAX will be performed during FY91 and FY92.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5013 28 September 1990

TITLE: Biochemical Testing of Potentially Hazardous Chemicals for Toxicity Using Mammalian Liver Cell Cultures

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 88C8116 WORK UNIT: 044

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS04, BS15

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, With 1st End, HQDA, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Morehouse School of Medicine, Atlanta, GA

PI: Parker, Curtis L. COR: Finch, Robert A.

OBJECTIVES: The objective is to develop and validate in vitro mouse and human liver cell (hepatoma) model systems which could be used as screening tests to assess the toxic potential and metabolism of chemicals.

APPROACH: In vitro responses of both human and mouse liver cells to toxic chemicals will be compared with known responses of the human liver to evaluate the predictive abilities of the in vitro systems. The response of the in vitro system will also be determined following exposure to known in vivo inducers of specific liver metabolizing enzymes. The hepatoxicity of chemicals in the in vitro systems will be determined through measurement of parameters including cytotoxicity, cell growth, cell morphology, and continued expression of cell-specific functions. Chemicals will be tested at several dose levels, using both single and multiple exposures. The reversibility of observed toxic responses will also be evaluated. Initial test chemicals will include benzo(a)pyrene (a known metabolizing enzyme inducer); 2-acetylaminofluorene (a chemical that is both hepatotoxic and carcinogenic in mice); p-hydroxyacedtamilide (hepatotoxic and carcinogenic in mice); dimethylnitrosamine (an hepatocarcinogen); and methylnitrosourea (another carcinogen that does not require metabolic activation).

PROGRESS: The results of preliminary studies using a human hepatoma cell line suggest that these cells react to the test chemicals in approximately the same way as similarly exposed mouse hepatoma cells. Additional research with the human hepatoma cells (HEP-G2) in which dose-response and time-response studies are being performed on the induction of glutathione-S-transferase, UDP glucuronal transferase, and arylhydrocarbon hydroxylase by exposure to benzo(a)pyrene are in progress. Preliminary results indicate exposure to as little as 2.5-5 ug/ml benz(a)pyrene results in enzyme induction in the HEP-G2 cells.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5014 28 September 1990

TITLE: Comparative Toxicity Studies Utilizing an Isolated Hepatocyte Model

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 88PP8856 WORK UNIT: 043

RAD: III TYPE OF FUNDING: 6.1 PROJ/TASK: BS04

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Environmental Protection Agency, Environmental Research Laboratory-Narragansett, Narragansett, RI

PI: Baksi, Sandra M. COR: Finch, Robert A.

OBJECTIVES: The purpose of this research is to establish an isolated hepatocyte culture system for medaka and to determine the utility of using fish cells in in vitro toxicity research.

APPROACH: Initially, methods will be developed for the isolation and culture of fish hepatocytes. Methods development work will include determination of the optimal conditions for the dissociation and subsequent culture of primary medaka hepatocytes. Due to the small size of the medaka, liver tissue samples will have to be obtained from several fish and pooled. Different enzymes will be used to dissociate the liver cells. Cell yield and viability will be determined. Once reliable methods for hepatocyte culture have been developed, the toxicity and biochemical effects of selected chemicals will be investigated.

PROGRESS: This project was terminated in the second quarter of FY90 due to a lack of progress in research. This is the final information paper on this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5015 28 September 1990

TITLE: Naturally-Derived Microcosms for Estimating Stress Effects in Aquatic Ecosystems

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: F633 CONTRACT: 88C8068 WORK UNIT: 013

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Pennsylvania State University, State College, PA

PI: Pratt, James R. COR: Shedd, Tommy R.

OBJECTIVES: The objective of this research is to develop, test, and validate an aquatic microcosm test that can be used to determine the toxicity of Army-relevant materials to aquatic ecosystems. The microcosm test will become a part of a mobile biomonitoring facility designed to evaluate the toxicity of potentially contaminated Army waters and wastewaters.

APPROACH: The sensitivity of an aquatic microcosm to toxicant stress will be determined by tests with pure compounds and complex mixtures. The sensitivity of several end points, including pH and dissolved oxygen changes, enzymes levels, and protein content will be evaluated. Validation will be accomplished by comparing microcosm responses to toxicants with effects on fish and aquatic invertebrates in field situations.

PROGRESS: Field biomonitoring studies with the protozoan microcosm system are continuing. At one sewage treatment plant, microcosm units were placed upstream and downstream of the discharge and benthic macroinvertebrate samples were taken for comparison of possible effluent effects. Little effect of the effluent either on the microcosms or on the macroinvertebrates was noted. Field and laboratory data have been collected at two additional sites, a foundry and a brass manufacturing plant. Effluents are difficult to test in the microcosm because high effluent concentrations tend to stimulate microcosm growth, due to high nutrient and bacterial loading. Also, oxygen concentrations and the levels of certain metals that are normally used as microcosms endpoints could not be used reliably in some cases due to effluents masking these parameters. Finally, organisms originating in the effluent tended to mask possible effects related to the migration process of organisms from the epicenter to the island sponge substrates. Four additional field sites were selected and are now being reviewed for acceptability for testing.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5016 28 September 1990

TITLE: New Rotifer Bioassays for Aquatic Toxicology

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 89Z9008 WORK UNIT: 004

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: University of Tampa, Tampa, FL

PI: Snell, Terry W. COR: Shedd, Tommy R.

OBJECTIVES: The objective of this research is to develop and test a simple relatively inexpensive bioassay that could be used to evaluate the toxicity of water and wastewater at Army facilities. Tasks include development of both an acute and a chronic bioassay using rotifers.

APPROACH: The freshwater rotifer, Brachionus calyciflorus, will be used. Acute and chronic tests will be initiated with newly-hatched rotifers obtained from dried resting cysts. Appropriate test conditions and end points will be established, and the sensitivity of the tests will be evaluated with a variety of toxicants.

PROGRESS: The effect of temperature on the acute toxicity of copper to the rotifer Brachionus calyciflorus has been determined. The acute toxicity of copper was greater at temperatures both above and below 20 degrees Celsius. A similar test for pentachlorophenol showed that toxicity was not affected by temperatures between 15 and 25 degrees Celsius, but toxicity was greater at temperatures of 10 and 30 degrees Celsius. The recommended temperature for the Brachionus assay is presently 25 degrees Celsius. The toxicity of several compounds to the rotifer were compared to both the fathead minnow and the cladoceran Daphnia magna. About two thirds of the compounds tested thus far have similar toxicities among the three species, but a larger data base is required before the data can be properly interpreted. Of the 84 acute tests conducted so far, 83 have met the criterion for having less than 10 percent control mortality. The protocol selected for the chronic test involves measurement of survival and population growth over a 48-hour period. Chronic assays have been conducted using 8 single compounds, with acute/chronic toxicity ratios ranging from 2 to 33. A preliminary evaluation of a dried algal product as food to be used in the chronic assay has demonstrated a response similar to the response observed when using live foods.

2d QUARTERLY SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5017 30 March 1990

TITLE: Development and Validation of Aquatic Toxicity Test Methods

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 87PP7862 WORK UNIT: 029

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV

PI: Sutton, William W. COR: van der Schalie, William H.

OBJECTIVES: The objective of this research is to develop and validate a standardized test protocol to determine the toxicity of contaminated soils to aquatic organisms. This test method can be used to evaluate the toxicity of soils at Army hazardous waste sites and other contaminated areas.

APPROACH: A candidate test method will be selected based on toxicant sensitivity as established in prior toxicity screening test results and a test protocol will be developed. The test protocol will be validated through both single laboratory evaluations and multiple laboratory collaborative tests.

PROGRESS: This study has helped to define the potential of an algal toxicity test for the toxicity screening of soil and other environmental samples. Although the algal assay has been found in previous studies to be sensitive to a wide range of toxicants, the assay was not particularly sensitive to the test compound used in this study (sodium fluoride). The variability in the test results was high relative to some chemical tests but was not unusual for biological assays. Overall, the algal assay test should be considered for use in evaluating environmental samples at Army sites, and could be used by itself or as part of a battery of tests. Interlaboratory testing of this method should be considered as a final step in method standardization. Work on this project has been completed, and a draft final report has been received. This is the final information paper on this project.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5018 28 September 1990

TITLE: Development of a Short-Term In Vitro Dermal Toxicity Screening Test Using Human Cells

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 89C9138 WORK UNIT: 201

RAD: III TYPE OF FUNDING: 6.5 PROJ/TASK: 802

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, With 1st End, HQDA, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: North American Science Associates, Inc., Northwood, OH

PI: Hume, R. Douglas COR: Finch, Robert A.

OBJECTIVES: The objective is to adapt and develop the Agarose Diffusion Method as a short-term in vitro dermal toxicity screening test using human cells. When developed, this test system will be useful for evaluating the dermal toxicity of Army-relevant chemicals.

APPROACH: The current Agarose Diffusion Method will be adapted for use in screening for primary skin irritation. This may require manipulation of the agarose gel thickness, varying the serum content in the culture medium, and using alternative cell types. Appropriate human cell lines will be adapted to the test method. Following adaptation of the test method, preliminary screening of known samples and comparison with rabbit dermal toxicity data will be conducted.

PROGRESS: This project was started (August 1989) under the Small Business Innovative Research Program. Required supplies have been purchased and research has been initiated utilizing newborn human foreskin cells (MRHF cell line) and the L-929 cell line. The effects of culture medium serum content and agarose thickness on sodium lauryl sulfate (SLS) toxicity in the MRHF and L-929 cell lines are being studied. The effect of agarose concentration on SLS toxicity on L-929 cells also is being studied. A primary dermal irritation test was performed in New Zealand white rabbits on a dilution series of SLS in order to provide comparative in vivo toxicity data on SLS. Final Phase I report has been received and accepted. Project was not funded for Phase II.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5019 28 September 1990

TITLE: In Vitro Respiratory Toxicity Screening Tests

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 89C9143 WORK UNIT: 175

RAD: III TYPE OF FUNDING: 6.5 PROJ/TASK: 802

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, With 1st End, HQDA, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Molecular Toxicology, Inc., Annapolis, MD

PI: Rundell, John O. COR: Finch, Robert A.

OBJECTIVES: The objective is to establish permanent, functionally-differentiated guinea pig respiratory epithelial cells for use in the development of short-term in vitro respiratory toxicity screening tests. When developed, this test system will be useful for evaluating the toxicity of Army-relevant chemicals.

APPROACH: Permanent guinea pig respiratory epithelial cell lines will be established using two strategies. One will involve the reversible transformation of the cells with the immortalizing and transforming large T antigen oncogene of SV40, under the control of the regulatable mouse metallothionein promoter. The other will involve the stable immortalization of the cells with the immortalizing but not transforming Ela oncogene of adenovirus, under constitutive, nonregulatable control of the SV40 promoter and retroviral long terminal repeats (LTR'S). The transformed immortalized respiratory epithelial cell lines thus obtained will be evaluated for their expression of the respiratory epithelial differentiated phenotype as compared to primary respiratory epithelial cell populations.

PROGRESS: This project was started (August 1989) under the Small Business Innovative Research Program. Required supplies have been purchased and research has been initiated. Studies are in progress to develop and optimize the in vitro culture conditions for the maintenance and growth of primary epithelial cell cultures derived from guinea pig tracheal epithelium. There was no reportable progress during the second quarter of FY90 because of a relocation of the contractor's laboratory facility. Contract was canceled because of lack of progress.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5020 28 September 1990

TITLE: A Novel System for Testing Dermal and Epidermal Toxicity In Vitro

PROPONENT COMMAND(S): U.S. Army Medical Research and Development Command

APC: CONTRACT: 89C9146 WORK UNIT: 173

RAD: III TYPE OF FUNDING: 6.5 PROJ/TASK: 802

REQUIREMENTS DOCUMENT: Letter, USAMRDC, SGRD-PLC, 6 Mar 86, subject: Health Hazard Assessment Priority Research Needs, With 1st End, HQDA, DASG-PSP, 29 May 86, and 2d End, USAMRDC, SGRD-PLC, 25 Jun 86

LOCATION: Marrow-Tech Incorporated, Elmsford, NY

PI: Naughton, Gail K. COR: Finch, Robert A.

OBJECTIVES: The objective is to develop and characterize a three-dimensional in vitro full-thickness human skin model for use in skin toxicity studies and as a model for skin penetration assays for toxins and pharmaceuticals. When developed, this test system will be useful for evaluating the toxicity of Army-relevant chemicals.

APPROACH: A human dermal equivalent consisting of dermal fibroblasts and naturally secreted collagens Type I and II will be analyzed. Fetal, neonatal, and adult dermal fibroblasts will be compared for rate of adherence, mitotic index, and secretion of matrix and growth factors. A full-thickness human skin equivalent consisting of a dermis (described above) along with melanocytes and fetal, neonatal or adult keratinocytes will be further developed. Standard toxicity assays will be used to determine the responses of the dermal equivalent and full-thickness skin equivalent to standard skin toxicants. The test system will be developed as a 96-well kit which can be utilized to assess dermal and epidermal toxicity using conventional assays and spectrophotometric analyzers.

PROGRESS: This project was started (August 1989) under the Small Business Innovative Research Program. Required supplies have been purchased and research has been initiated. An inventory of neonatal and adult keratinocytes and fibroblasts has been established. Studies are in progress which involve the development of assay systems utilizing the full-thickness human skin equivalent for assessing skin cytotoxicity and irritation caused by exposure to dermal toxicants. Final Phase I report has been received and accepted. Project was not funded for Phase II.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5021 28 September 1990

TITLE: Development and Adaptation of Toxicity Tests for Direct In Situ Ecological Assessments

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 89PP9950 WORK UNIT: 027

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Environmental Protection Agency, Environmental Research Laboratory-Corvallis, Corvallis, OR

PI: Williams, William COR: Finch, Robert A.

OBJECTIVES: The objective of this research is to develop and validate on-site toxicity assessment techniques for evaluation of potential ecological effects at hazardous waste sites. These techniques can then be utilized for the assessment of contaminated Army sites.

APPROACH: Test protocols will be developed and validated for assessing the toxicity of contaminated soil and water at hazardous waste sites. Test methods to be evaluated initially include the Frog Embryo Teratogenicity Assay - Xenopus (FETAX), a seed germination test, and an earthworm toxicity test. These laboratory-based methods will be reconfigured for use under field conditions. Field testing will be done at local sites near the Corvallis Environmental Protection Agency Laboratory (USEPA) as well as at hazardous waste sites located in California and Massachusetts. Test methods will be refined based on field experience. Environmental conditions suitable for conducting the tests will be determined. Additional test methods, including those with sublethal test end points, will be utilized in future research efforts.

PROGRESS: This project was initiated in June 1989. Laboratory test protocols have been modified to be suitable for field use. Initial field trials of the seed germination test and the earthworm toxicity test are in progress. A test protocol has been prepared for the in situ application of the FETAX. Testing of this protocol is in progress in a laboratory environment. The PI has been changed at the USEPA lab and a site visit is planned in the first quarter of FY91.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5022 28 September 1990

TITLE: Evaluation of Exposure Markers

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 89PP9951 WORK UNIT: 032

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NE

PI: Nauman, Charles COR: Finch, Robert A.

OBJECTIVES: The objective of this project is to develop biological markers and determine which of these techniques would be most useful in assessing the potential human health or environmental effects of materials relevant to the Army.

APPROACH: This effort will be done in collaboration with the United States Environmental Protection Agency's program in biomarker development. The initial efforts will include an examination of the literature for promising techniques and the subsequent pursuit of those methods judged most useful. These techniques will be applied by the Laboratory scientists in both on-site assessment and laboratory chemical bioassays. Several techniques have been identified and will be modified for incorporation into this Laboratory research program. These include the use of serum protein adducts as a biomarker for exposure to chemicals capable of covalently binding to cellular macromolecules.

PROGRESS: A microgel electrophoresis assay has been developed for directly evaluating, in individual cells, the frequency of single strand DNA breaks and/or alkali-labile sites. The focus of the research has been on evaluating the specificity and sensitivity of the technique with a variety of genotoxic and nongenotoxic chemicals; developing methods for isolating individual cells from organs of rodents; evaluating the kinetics of DNA damage induced in various organs by a representative environmental genotoxic pollutant; examining the applicability of the assay to human peripheral blood leukocytes; and comparing the levels of DNA damage in the organs of mice collected at Superfund and control sites. This technique will provide, with greater sensitivity, data on the induction and persistence of organ-specific levels of DNA damage resulting from environmental exposure to genotoxic pollutants. The final draft report has been received and reviewed. Collaborative research between the investigator and this Lab using the single cell gel electrophoresis techniques is currently being planned.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5023 28 September 1990

TITLE: Adduction of Nitroaromatic Compounds with Blood Proteins and DNA as Biological Markers of Exposure

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: 90PP0812 WORK UNIT: 315

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Biochemical and Molecular Toxicology, Health Effects Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, OH 45238

PI: Reddy, Tirumuru V. COR: Reddy, Gunda

OBJECTIVES: The principal objectives of the proposed studies are to determine the ability of 1,3-dinitrobenzene (DNB), 1,3,5-trinitrobenzene (TNB) and tetryl to form covalent adducts with blood proteins and deoxyribonucleic acid (DNA) in target organs and to utilize these data for estimating intake and assessing toxicity and risk of exposure due to these compounds.

APPROACH: To measure DNB, TNB, and tetryl adducts of blood protein and young male rats will be dosed orally with radioactive chemicals at levels selected on the basis of published LD50 values. A series of four experiments will be conducted: (a) to determine the optimum time for adduct formation (binding); (b) to assess the kinetics of adduct formation; (c) to determine the persistence of the DNB, TNB, and tetryl adducts formed with hemoglobin and DNA; and (d) to determine the effect on adduct formation of varying dosing regimen. In all experiments, the procedures will include blood collection and fractionation of blood proteins into globin, albumin, and globulin, and isolation of DNA from frozen tissues.

PROGRESS: Custom-synthesized 14C-TNB has been received. Experiments to determine the optimum time required for maximum adduction of TNB with blood proteins and DNA have been completed. The maximum adduction of TNB with blood proteins occurred within 24 hours with albumin and within 48 hours with globin and globulin which persisted up to 21 days. The maximum DNA adducts occurred with stomach tissue followed by liver and spleen. Experiments to determine the formation and persistence of adducts by single and multiple doses are in progress. The principal investigator is planning to complete the TNB work. This work unit has been temporarily terminated due to severe budget cuts. This work will be reactivated if funds become available.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5024 28 September 1990

TITLE: Development of an Aquatic Bioassay Using the Medaka (Oryzias latipes) to Assess Human Health Risk: *Tumor Immunodiagnosis*

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: WORK UNIT: 057

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Johns Hopkins University, Baltimore, MD

PI: Bunton, Tracie E. COR: Finch, Robert A.

OBJECTIVES: The objective is to adapt and use immunohistochemical (IHC) techniques developed for use in human and veterinary medicine in conjunction with standard morphologic methods to diagnose and trace the progression of chemically-induced proliferative and neoplastic lesions in the medaka.

APPROACH: Fish will be exposed to known mammalian carcinogens at USABRDL and held for 12 months following exposure. Fish will be periodically transported to Johns Hopkins University where they will be sacrificed and processed. Lesion types will be characterized and their progression noted.

PROGRESS: This is a new project for FY91. Contract negotiation are in progress.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5025 28 September 1990

TITLE: Molecular Analysis of Medaka Tumors: New Models for Carcinogenicity Testing

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: WORK UNIT:

RAD: III TYPE OF FUNDING: 6.3 PROJ/TASK: DERA

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Duke University Marine Laboratory, Beaufort, NC

PI: Van Beneden, R. COR: Gardner, Henry S., Jr.

OBJECTIVES: The Japanese medaka (Oryzias latipes) can be used in the development of sensitive in vivo bioassays using medaka fish and in vitro systems using medaka cell lines for the detection of potentially harmful environmental contaminants.

APPROACH: The proposed work will clarify the normal tissue-specific developmental pattern of expression of cellular oncogenes and the mechanism(s) of activation of oncogenes in chemically-induced tumors in the medaka. Tumors will be induced by exposure of medaka to known human carcinogens and potentially carcinogenic aquatic contaminants. DNA and RNA will be isolated from tumors and activated oncogenes will be identified by either (1) the preparation and analysis of subtraction libraries or (2) transfection analysis. Transforming genes identified by these methods will be characterized as to their expression, sequence homology to known oncogenes, and their method of activation in tumor cells. Medaka cell lines will be developed from normal and tumor tissues for in vitro work. The in vivo and in vitro assays using medaka as an appropriate nonmammalian model system will thus allow for the examination of basic mechanisms of chemical carcinogenesis which will form the basis for the development of new carcinogen tests.

PROGRESS: This is a new project for FY91. Contract negotiations are in progress.

SEMIANNUAL SUMMARY INFORMATION PAPER, FY90

RESEARCH METHODS BRANCH
HEALTH EFFECTS RESEARCH DIVISION

BRDL NUMBER: RMBE-5026 28 September 1990

TITLE: Development of A Carcinogenicity Model Using the Zebra Fish

PROPONENT COMMAND(S): U.S. Army Corps of Engineers

APC: CONTRACT: WORK UNIT: 031

RAD: III TYPE OF FUNDING: 6.2 PROJ/TASK: A835

REQUIREMENTS DOCUMENT: U.S. Army Corps of Engineers, Office of the Chief of Engineers, Long-Range Science and Technology Plan, Volume III, Environmental Quality Technology, March 1989

LOCATION: Oregon State University, Corvallis, OR

PI: Hendricks, Jerry D. COR: Gardner, Henry S., Jr.

OBJECTIVES: The objective of this research is to evaluate the use of the zebra fish (Brachydanio rerio) as a second species (in addition to the Japanese medaka) for carcinogenicity assessments of Army-relevant materials.

APPROACH: The response of zebra fish will be monitored following exposure to known mammalian carcinogens. The incidence of tumors and the nature of the lesions will be noted and compared both to other fish species similarly exposed and to mammals. In addition, genetic alterations found in zebra fish after exposure to carcinogens will be evaluated.

PROGRESS: This is a new project for FY91. Contract negotiations are in progress.

THIS PAGE INTENTIONALLY LEFT BLANK.

PRODUCTIVITY

FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

SPECIFICATIONS WRITTEN

MIL-S-14102	Sprayer, Insecticide, Manually-Carried, Hand-Operated-Compression (Revised).
A-A-52286	Commercial Item Description - Sprayer, Pesticide, Pushcart Mounted.
MIL-S-XXXXX(DM)	Sink Unit, Surgical Scrub, Field.

PATENTS

A patent application for the LeMark Far-Forward Surgical Table was submitted 13 June 1990. The LeMark Far-Forward Surgical Table is a portable surgical table to be used with military litters to provide a stable platform for surgical procedures in far-forward field operations. The table includes as attachments: three IV poles, two halogen lamps, two side-mounted arm boards, a trash-bag holder, a tray for anesthesia equipment/ventilator/patient monitors and/or life support equipment and a side-mounted instrument tray. The frame is portable and easily assembled. The frame is constructed of square aluminum tubing joined together with cast aluminum couplings and weighs 85 pounds.

A patentability search of the invention disclosure entitled "An Improved Laboratory Test Cage for Testing Repellents on Human Volunteers" (Log No. 90-16) was completed 13 July 1990, and the Patents, Copyrights and Trademarks Division, Office of The Judge Advocate General, Department of The Army, elected to prepare a patent application.

Semi-Micro Manipulator, U.S. Patent No. 4,941,631. Issued to D.W. Misch, 17 July 1990. This device was developed for injecting substances into mosquito larvae intestines.

PUBLICATIONS AND PRESENTATIONS

Open Literature Publications:

Boobar, L.R. 1990. Program overview - the BRDL vision. In Proceedings of the U.S. Army Medical Department biennial medical entomology training course, 107-08. San Antonio, TX.

Burrows, W.D., and J.H. Nelson. 1990. IV fluidmaker: prepartion of sterile water for injection in a field setting. In Proceedings of the Army science conference, Durham, NC. In press.

Edgecomb, R.S. 1990. Vector control advisor system - a new level of readiness. In Proceedings of the U.S. Army Medical Department biennial medical entomology training course, 109-10. San Antonio, TX.

Gupta, R.K. 1990. Composite repellents - an innovative concept in personal protection. In Proceedings of the U.S. Army Medical Department biennial medical entomology training course, 113-14. San Antonio, TX.

Gupta, R.K., L.C. Rutledge, and D.W. Korte, Jr. 1990. Portable tray for anesthetizing and sorting insects. J. Med. Entomol. 27:406-08.

Gupta, R.K., L.C. Rutledge, W.G. Reifenrath, G.A. Gutierrez, and D.W. Korte, Jr. 1990. Resistance of permethrin-treated fabric to weathering for protection against mosquitoes. J. Med. Entomol. 6:494-500.

Gupta, R.K. 1989. Insect repellents - past, present and future. In Proceedings for the international symposium on hematophagous insect attractants. Metropolitan Mosquito Control District, St. Paul, MN. In press.

Gupta, R.K., and D.W. Korte, Jr. 1989. Mutagenic potential of nitroguanidine and nitrosoguanidine in the Drosophila melanogaster sex-linked recessive lethal test. CPIA Publication 508:101-10.

Gupta, R.K., L.C. Rutledge, and W.J. Letourneau. 1989. An improved laboratory test cage for testing repellents on human volunteers. J. Am. Mosq. Control Assoc. 5:436-39.

Perich, M.J. 1990. Integrated vector control strategies - methodologies for disease control in the future. In Proceedings of the U.S. Army Medical Department biennial medical entomology training course, 115-16. San Antonio, TX.

Perich, M.J., and L.R. Boobar. 1990. Effects of the predator Dugesia dorotocephala (Tricladida: Turbellaria) on selected nontarget aquatic organisms: Laboratory bioassay. Entomophaga 35:79-83.

Perich, M.J., L.R. Boobar, J.C. Stivers, and L.A. Rivera. 1990. Evaluation of diverse formulations of B.t.i. against Anopheles albimanus in Honduras. In Proceedings of the coordination workshop on bacterial control of agriculture insect pests and vectors of human diseases. En Gedi, Israel. Israel J. Entomol. In press.

Perich, M.J., L.R. Boobar, J.C. Stivers, and L.A. Rivera. 1990. Field evaluation of four biorational larvicide formulations against Anopheles albimanus in Honduras. Med. Vet. Entomol. In press.

Perich, M.J., P.M. Clair, and L.R. Boobar. 1990. Integrated use of planaria (Dugesia dorotocephala) and Bacillus thuringiensis var. israelensis against Aedes taeniorhynchus: Laboratory bioassay. J. Am. Mosq. Control Assoc. In press.

Perich, M.J., M.A. Tidwell, L.R. Boobar, D.C. Williams, C.J. Pena, and M.R. Sardelis. 1990. Comparison of ground and aerial ultra-low volume applications of malathion against Aedes aegypti in Santo Domingo, Dominican Republic. J. Am. Mosq. Control Assoc. 6:1-6.

Rutledge, L.C., R.L. Hooper, R.A. Wirtz, and R.K. Gupta. 1989. A field trial of ethyl hexanediol against Aedes dorsalis in Sonoma County, California. J. Am. Mosq. Control Assoc. 5:374-76.

Rutledge, L.C., R.L. Hooper, R.A. Wirtz, and R.K. Gupta. 1989. Efficacy of diethyl methylbenzamide (DEET) against Aedes dorsalis and a comparison of two end points for protection time. J. Am. Mosq. Control Assoc. 5:363-68.

Solberg, V.B., F.H. Broski, R.E. Dinterman, and D.T. George. 1989. Penetration of [^{3}H]T-2 mycotoxin through abraded and intact skin and methods to decontaminate [^{3}H]T-2 mycotoxin from abrasions. Toxicon 28:803-11.

Wells, C., W. Bertsch, and M. Perich. 1990. In search of naturally occurring insecticides. Application of GC, LC, SFE and hyphenated techniques. Preliminary studies. In Proceedings for the 12th international symposium capillary chromatography. Tokyo, Japan. In press.

Presentations:

Boobar, L.R. 1990. Program overview - the BRDL vision. Paper presented at The U.S. Army Medical Department Biennial Medical Entomology Training Course, 5-9 February, at San Antonio, TX.

Edgecomb, R.S. 1990. Vector control advisor system - a new level of readiness. Paper presented at The U.S. Army Medical Department Biennial Medical Entomology Training Course, 5-9 February, at San Antonio, TX.

Gupta, R.K. 1990. Composite repellents - an innovative concept in personal protection. Paper presented at The U.S. Army Medical Department Biennial Medical Entomology Training Course, 5-9 February, at San Antonio, TX.

Gupta, R.K. 1989. Resistance of weathering on fabrics treated with permethrin for protection against mosquitoes. Paper presented at The Entomological Society of America Centennial Meeting, 10-14 December, at San Antonio, TX.

Gupta, R.K. 1989. Insect repellents - past, present and future. Paper presented at The International Hemophagous Insect Attractants Symposium, Metropolitan Mosquito Control District, 7-11 November, at St. Paul, MN.

Perich, M.J. 1990. Integrated vector control strategies - methodologies for disease control in the future. Paper presented at The U.S. Army Medical Department Biennial Medical Entomology Training Course, 5-9 February, at San Antonio, TX.

Perich, M.J. 1990. Research on malaria and dengue vector control in Honduras and the Dominican Republic. Paper presented at The Invitational Symposium on the Biology and Control of Vectors of Tropical Diseases, Pan American Health Organization, 17-20 May, at Mexico City, Mexico.

Perich, M.J., M.A. Tidwell, M.R. Sardelis, D.C. Williams, C.J. Pena, and L.R. Boobar. 1989. Evaluation of barrier spraying for the control of malaria in the Dominican Republic. Paper presented at 38th Annual Meeting of The American Society of Tropical Medicine and Hygiene, 10-14 December, at Honolulu, Hawaii.

Solberg, V.B. 1989. Field evaluation of two formulations of cyfluthrin for control of ticks (Ixodes dammini; Amblyomma americanum). Paper presented at The Entomological Society of America Centennial Meeting, 10-14 December, at San Antonio, TX.

Strzelecki, L.R. 1990. Research and readiness. Paper presented at 1990 Forces Command Conference, 7-11 March, at Atlanta, GA.

Sumko, M.H., G. Pennington, A. Bucknell, D.L. Danley, and J.H. Nelson. 1989. Pulsed, non-thermal, high frequency electromagnetic energy (diapulse) in treatment of first and second degree ankle sprains. Paper presented at Society of Military Orthopedic Surgeons 31st Annual Meeting, 10-15 December, at San Antonio, TX.

In-House Publications:

Technical Reports

Dubill, P.M., and L.R. Strzelecki. 1990. Evaluation of commercial pneumatic bandage. Technical Report No. 9003.

Reams, W.H., D.D. Baker, Jr., and S.W. Reichard. 1990. Adjustable field hospital bed: effects of prototype leg braces on stability, load-bearing capacity, and rough terrain use. Technical Report No. 9004.

Memorandum Reports

Hodge, J.W. 1989. Convulsant antidote nerve agent autoinjector altitude test. Memorandum Report No. 20-89.

Hodge, J.W., and G.E. Toms. 1989. New lightweight surgical scrub sink, power module. Memorandum Report No. 21-89.

Hodge, J.W. 1990. Temperature effects on dispersal of atropine aerosol. Memorandum Report No. 1-90.

Gula, P.R., and G.E. Toms. 1990. Technical testing of the steam vacuum pulse (SVP) sterilizer manufactured by MDT Castle Corporation. Memorandum Report No. 2-90.

Hodge, J.W., and G.E. Toms. 1990. Environmental protection container, medical supplies 1st article test. Memorandum Report No. 3-90.

Hodge, J.W., P.R. Gula, and G.E. Toms. 1990. Pesticide dispersal unit, multicapability helicopter slung, first article test. Memorandum Report No. 4-90.

Hodge, J.W., and G.E. Toms. 1990. Convulsant antidote nerve agent autoinjectors test report. Memorandum Report No. 5-90.

Hodge, J.W., and G.E. Toms. 1990. Convulsant antidote nerve agent autoinjector follow on technical test. Memorandum Report No. 6-90.

Hodge, J.W., and G.E. Toms. 1990. Multichamber autoinjector (DUPHAR) follow on technical test. Memorandum Report No. 7-90.

Hodge, J.W., and G.E. Toms. 1990. Multichamber autoinjector (Survival Tech) follow on technical test. Memorandum Report No. 8-90.

Gula, P.R., and G.E. Toms. 1990. Readiness testing of portable oxygen concentrators (Portox). Memorandum Report No. 9-90.

Hodge, J.W., and G.E. Toms. 1990. Nerve agent pretreatment pyridostigmine follow on test report. Memorandum Report No. 10-90.

Hodge, J.W., and G.E. Toms. 1990. Litter decontaminable 1st article test Memorandum Report No. 11-90.

Hodge, J.W. 1990. Individual Dynamic absorption kit (IDAA). Memorandum Report No. 12-90.

Hodge, J.W., and G.E. Toms. 1990. Convulsant antidote, nerve agent, training test report. Memorandum Report No. 13-90.

Judge, J., and P. Gula P. 1990. Test and evaluation of resuscitation device, individual, chemical. Memorandum Report No. 14-90.

Gula, P.R. 1990. Technical review comments for PDU manual. Memorandum Report No. 15-90.

Hodge, J.W., and G.E. Toms. 1990. Survival technology MA. improved dispersal test report. Memorandum Report No. 16-90.

Hodge, J.W., and G.E. Toms. 1990. Duphar MA type A90. Memorandum Report No. 17-90.

Hodge, J.W., and G.E. Toms. 1990. Duphar MA type B90 test report. Memorandum Report No. 18-90.

Extramural Study Reports/Publications

Burke, J.W. 1990. Nozzle assembly for Army mass delousing outfit. Final report, phase I, DAMD17-89-C-9131. Waldorf, MD: Cardinal Scientific, Inc.

Motz, J.W. 1990. Sealed rotating anode x-ray tube with enhanced power and duty cycle. Final report, phase I, DAMD17-89C-9133. Rockville, MD: Rayex Corporation.

Peschmann, K.R. 1990. High duty cycle, high power x-ray tube. Final report, phase I, DAMD17-89C-9139. San Francisco, CA: Imatron, Incorporated.

OTHER TECHNICAL EXCHANGE

The DOD Aerial Spray Course was taught by Specialist Brett W. Collier, at Rickenbacker Air National Guard Base, Columbus, OH, 15-20 October 1989.

The USABRDL sponsored a Special Operations Forces Conference to discuss field medical materiel needs, 30-31 October 1989. During the conference current deficiencies and anticipated future needs for the field were reviewed.

A USABRDL representative attended the scoring conferences on the Steam Vacuum Pulse Sterilizer at Fort Sam Houston, 20 December 1989 and 21 February 1990.

A USABRDL representative attended the U.S. Army Health Services Command Test Schedule and Review Committee Working Group meetings at Fort Sam Houston, TX, 29 January 1990 and at the Pentagon, Washington, DC, 27 June 1990.

A USABRDL representative participated in Test Integration Working Group for Deployable Medical Systems X-Ray Medical Materiel Set, D307, form, fit, and function held at the U.S. Army Medical Department Board, Fort Sam Houston, TX, 15 February 1990.

A USABRDL representative attended a Deployable Medical Systems field exercise at Camp Williams, UT, 12-16 February 1990.

A USABRDL representative attended a design review meeting of the Ethylene Oxide Sterilizer at the MDT Corporation, Rochester, NY, 5-8 March 1990.

A demonstration of the Field Clinical Laboratory was presented by Ms. Patricia M. Dubill, USABRDL, 27 April 1990.

Market survey feasibility analyses of Surgical Positioning Devices were conducted for the Defense Medical Standardization Board, 15 August 1990.

Market survey feasibility analyses of a Field Fracture Table were conducted for the Defense Medical Standardization Board, 16 August 1990.

A briefing book of combat casualty care equipment was prepared for the USAMRDC Commander's Conference and the Assistant Secretary of Health Affairs.

The USABRDL participated and presented data at the following conferences during FY90:

International Symposium, Human Factors in Medical Devices, Plymouth, MA, 13-15 December 1989.

FORSCOM Medical Conference, Atlanta, GA, 7-11 March 1990.

National Association of Orthopedic Nurses Conference, Chicago, IL, 9-14 June 1990.

National Guard Conference, Camp Robinson, AR, 29-30 June 1990.

First International Conference, Anesthesia and Critical Care in Disasters and War, London, England, 18-21 July 1990.

Army Nursing Research Conference, Washington, DC, 7 August 1990.

THIS PAGE INTENTIONALLY LEFT BLANK.

HEALTH EFFECTS RESEARCH DIVISION

PUBLICATIONS AND PRESENTATIONS

Open Literature Publications:

Bates, H.K., J.B. LaBorde, J.C. Dacre, and J.F. Young. 1990. Developmental toxicity of Soman in rats and rabbits. Teratology 42:15-23.

Burrows, W.D. 1990. Biological treatment of an explosives production wastewater. In Proceedings of the 22nd mid-Atlantic industrial waste conference, 339-54. Lancaster, PA.

Calabrese, E.J., W.D. Burrows, S.A. Schaub, J. Borzelleca, D. Brown, R. Bull, A. Furst, C. Gerba, E. Singley, V. Snoeyink, R. Tardiff, and R. Trussell. 1989. Drinking Water Health Effects Task Force. Health effects of drinking water treatment technologies. Chelsea, MI: Lewis Publishers Inc.

Finch, R.A., H.S. Gardner, and W.H. van der Schalie. 1990. Application of on-site biological assessment techniques at Army facilities. In Proceedings of the 17th environmental symposium, 295-301. American Defense Preparedness Association, Atlanta, GA.

Gardner, H.S., W.H. van der Schalie, M.J. Wolfe, and R.A. Finch. 1990. New methods for on-site biological monitoring of effluent water quality. In In Situ evaluations of biological hazards of environmental pollutants, ed. S.S. Sandhu, 61-9. New York: Plenum Press.

Goldman, M., and J.C. Dacre. 1989. Lewisite: Its chemistry, toxicology and biological effects. Reviews of Environmental Contamination and Toxicology, 110:75-115.

Hoke, S.H., J. Skrutskie, and B.J. Christensen. 1990. Development of a hydrogen fluoride monitor. In Proceedings of the 1990 JANNAF safety and environmental protection subcommittee meeting. Publication 543, Chemical Propulsion Information Agency, Laurel, MD.

Levine, B.S., E.M. Furedi, D.E. Gordon, J.J. Barkley, and P.M. Lish. 1990. Toxic interactions of the munitions compounds TNT and RDX in F344 rats. Fund. Applied Toxicology 15:373-80.

Major, M.A., K.A. Bostian, and D.H. Rosenblatt. 1990. The octanol/water partition coefficient of methylmercuric chloride and methylmercuric hydroxide in pure water and salt solutions. Environ Toxicol and Chem. In press.

McCarthy, J.F., H. Gardner, M.J. Wolfe, and S.R. Shugart. N.d. DNA alterations and enzyme activities in Japanese medaka (Oryzias latipes) exposed to diethylnitrosamine. Neuroscience and Biobehavioral Reviews. In press.

Norton, W.N., and H. Gardner. 1990. Diethylnitrosamine induced spongiosis hepatis in medaka, Oryzias latipes. In Proceedings of the XIIth international congress for electron microscopy, 370-71. San Francisco, CA: San Francisco Press, Inc.

Rosenblatt, D.H., E.P. Burrows, W.R. Mitchell, and D.L Parmer. 1990. Explosives and related compounds. In The handbook of environmental chemistry: Anthropogenic compounds, ed. O. Hutzinger. Heidelberg, Germany: Springer-Verlag. In press.

Schaub, S.A. 1989. An overview of POU and POE microbiological water purification technologies and an approach to evaluating their effectiveness. In Proceedings of the fifth national domestic water quality symposium, 34-45. New Orleans, LA.

Schaub, S.A. 1990. Brightstar 90 - Consultation on preventive medicine for field drinking water. USAMRDC Newsletter, January.

Small, M.J. 1989. The preliminary pollutant limit value approach: The PC-executable program version. In Proceedings of the 14th annual Army environmental R&D symposium, 595-99. Williamsburg, VA.

Van Beneden, R.J., K.W. Henderson, D.G. Blair, T.S. Papas, and H.S. Gardner. 1990. Oncogenes in hematopoietic and hepatic fish neoplasms. Cancer Research (Supplement) 50:5671s-74s.

Presentations:

Allen, J.T. 1989. The alveolar breath method of determining COHb. Paper presented at the 96th Annual Association of Military Surgeons' Convention, November, at San Diego, CA.

Allen, J.T. 1990. Aspects of field preventive medicine. Paper presented at a U.S. Army Environmental Hygiene Agency Meeting, Edgewood Arsenal, 12 May, at Aberdeen Proving Ground, MD.

Burrows, W.D. 1990. Some chemistry and a little biochemistry of military nitramines. Paper presented at National Cancer Institute-Frederick Cancer Research Facility, Organic Chemistry Discussion Group, May, at Fort Detrick, Frederick, MD.

Burrows, W.D. 1990. Biological treatment of an explosives production wastewater. Paper presented at the 22nd Mid-Atlantic Industrial Waste Conference, July, at Philadelphia, PA.

Checkai, R.T., C.T. Phillips, M.A. Major, and R.S. Wentsel. 1989. Movement of munition residues in soil under conditions of artificial acid rain thru-put. Paper presented at Annual American Soil Association Meeting, 21-26 October, at San Antonio, TX.

Checkai, R.T., C.T. Phillips, M.A. Major, and R.S. Wentsel. 1989. Movement of munition residues in soil under conditions of artificial acid rain thruput. Paper presented at Annual Society of Environmental Toxicology and Chemistry Meeting, 28 October-2 November, at Toronto, Canada.

Gardner, H.S. 1990. Japanese medaka as biomonitors for munitions site cleanup. Paper presented at Oregon State University, August, Corvallis, OR.

Gardner, H.S. 1990. New models for environmental assessment. Paper presented at the National Institute of Environmental Health Sciences, April, Research Triangle Park, NC.

Gardner, H.S. 1990. On-site assessment of environmental mixtures. Paper presented at Conference on Drinking Water and Health, May, Amherst, MA.

Gardner, H.S. 1990. Field evaluation of fish cancer assay with complex mixtures. Paper presented at the Chemical Manufactures Association, Aquatic Models in Carcinogenicity Workshop, 30-31 January, Washington, DC.

Garrett, L., S. Zinnanti, W. Norton, H. Gardner, and R. Finch. 1990. Development and characterization of primary cultures of cells derived from the liver of the Japanese medaka fish (Oryzias latipes). Poster presentation at the 1st Annual Meeting of the Tissue Culture Association, 10-13 June, Houston, TX.

Hoke, S.H., J. Skrutskie, and B.J. Christensen. 1990. Development of a hydrogen fluoride monitor. Paper presented at the 1990 JANNAF Safety and Environmental Protection Subcommittee Meeting, June, at Livermore, CA.

Hoke, S.H. 1990. Development of toxic gas monitors to characterize rocket exhaust. Slide presentation at Shippensburg University, 14 September, at Shippensburg, PA.

Schaub, S.A., H.T. Hargett, and K.I. Kamrud. 1990. Evaluation of the military effectiveness of Chlor-Floc water purification tablets. Poster presentation at the Drinking Water and Public Health Symposium, 30 April-2 May, at Amhurst, MA.

Schaub, S.A. 1990. Drinking water for the Army in the field. Poster presentation at Armed Forces Day, 17 May, at Fort Detrick, Frederick, MD.

Schaub, S.A. 1990. Current projects in field drinking water research and development. Paper presented at Army Environmental Hygiene Agency Water Quality Workshop, 14-18 May, at Aberdeen Proving Ground, MD.

Small, M.J. 1990. A PC-executable program for health hazard assessment evaluations of environmental pollutants. Paper presented at the American Defense Preparedness Association symposium, 18-20 April, at Atlanta, GA.

Small, M.J. 1990. An integrated system of endangerment assessment involving phytotoxic responses. Poster presentation at the American Society for Testing and Materials, 23-24 April, at San Francisco, CA.

In-House Publications:

Technical Reports

Carnevale, R.M., and W.D. Burrows. 1989. Optimum disinfection properties and commercially available disinfectants. Technical Report No. 8911. AD A219332.

Dacre, J.C., and W.D. Burrows. 1988. Recommended field drinking water criteria for chemical agent sulfur mustard. Technical Report No. 8816. AD A221745.

Major, M.A. 1989. Octanol/water partition coefficients of surface and ground water contaminants found at military installations. Technical Report No. 8810.

Mitchell, W.R., and E.P. Burrows. 1990. Assessment of red phosphorus in the environment. Technical Report No. 9005. AD A221704.

Neal, D.D., S.H. Hoke, and W.P. Spencer. 1990. NO_x -- sources, properties, and analytical procedures. Technical Report No. 8907. AD A225295.

Palmer, W.G. 1990. Field water quality standards for BZ. Technical Report No. 9001. AD A220896.

Schmidt, M.O., R.M. Carnevale, and W.D. Burrows. 1989. Shower water recycle I. Raw shower water characterization and treatment. Technical Report No. 8904. AD B141375.

Small, M.J. 1989. The pollutant hazard assessment system: Documentation and user's manual. Technical Report No. 9003. AD A217108.

Young, J.Y., D.A. Smart, J.T. Allen, D.L. Parmer, A.B. Rosencrance, E.E. Bruggemann, and F.H. Broski. 1989. Field exposure of chemical school students and cadre to fog oil and hexachloroethane (HC) smokes. Technical Report No. 8908. AD A225008.

Extramural Study Reports/Publications/Presentations:

Aranyi, C. 1990. Inhalation toxicity of single materials and mixtures: Phase I - Design and characterization of animal exposure facility. Contract No. DAMD17-89-C-9043. Chicago, IL: IIT Research Institute. AD A224937.

Bailey, G.S., D.E. Goeger, and J.D. Hendricks. N.d. Factors influencing carcinogenesis by polynuclear aromatic hydrocarbons or other genotoxins in laboratory fish models. In PAH Metabolism in the Aquatic Environment, ed. U. Varanasi. Boca Raton, FL: CRC Press. In press.

Bailey, G.S., and J.D. Hendricks. N.d. Environmental and dietary modulation of carcinogenesis in fish. Aquatic Toxicology. In press.

Baldwin, L.A., E.J. Calabrese, P.T. Kostecki, and Jae-Ho Yang. 1990. Isolation of peroxisomal enoyl-CoA hydratase in rainbow trout and immunochemical identification with the bifunctional enzyme. Fish Physiology and Biochemistry 8(4):347-51.

Bantle, J.A., D.J. Fort, and B.L. James. 1989. Identification of developmental toxicants using FETAX. Hydrobiol. 188/189:577-85.

Benignus, V.A., K.E. Muller, and C.M. Malott. 1990. Dose-effects functions for carboxyhemoglobin and behavior. Neurotoxicol. Teratol. 12(2):111-18.

Benignus, V.A., K.E. Muller, M.V. Smith, K.S. Pieper, and J.D. Prah. 1990. Compensatory tracking in humans with elevated carboxyhemoglobin. Neurotoxicol. Teratol. 12(2):105-10.

Benignus, V.A., M.L. Petrovick, and J.D. Prah. 1989. Neurobehavioral effects of carbon monoxide in humans: Elevated carboxyhemoglobin (COHb) and cerebrovascular responses. Project Order Number 81PP1812. Research Triangle Park, NC: U.S. Environmental Protection Agency.

Bowman, B., T.W. Snell, and B.J. Cochrane. 1989. Purification and characterization of glutathione S-transferases from two species of rotifers. Comp. Biochem. Physiol. 95B:619-24.

Brower, M.E., and W.R. Hartley. 1990. Health advisory for nitroguanidine (NQ). Project Order Number 85PP5869. Washington, DC: U.S. Environmental Protection Agency, Office of Drinking Water.

Brown, D.F., W.E. Dunn, and A.J. Policastro. 1990. Assessment and computerized modeling of the environmental deposition of military smoke:analysis of meteorological data from the AMADEUS smoke dispersion experiments. Project Order Number 90PP0819. Argonne, IL: Argonne National Laboratory. In press.

Brown, L.D., C.R. Wheeler, and D.W. Korte. 1989. Acute oral toxicity of DIGL-RP solid propellant in Sprague-Dawley rats. Institute Report Number 409. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Brown, L.D., J.D. Justus, and D.W. Korte. 1989. Acute dermal toxicity of DIGL-RP solid propellant in rabbits. Institute Report Number 407. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Brown, L.D., and D.W. Korte. 1989. Primary dermal irritation potential of DIGL-RP solid propellant in rabbits. Institute Report Number 406. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Brown, L.D., and D.W. Korte. 1989. Primary dermal irritation potential of ball powder in rabbits. Institute Report Number 349. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A211285.

Brown, L.D., C.R. Wheeler, Y.C. Letellier, and D.W. Korte. 1989. Acute oral toxicity of DIGL-RP solid propellant in ICR mice. Institute Report Number 410. Presidio of San Francisco: Letterman Army Institute of Research.

Brown, L.D., Y.C. Letellier, C.R. Wheeler, and D.W. Korte. 1989. Acute oral toxicity of trimethylolethane trinitrate (TMETN) in ICR mice. Institute Report Number 345. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A211993.

Brown, L.D., J.D. Justus, C.R. Wheeler, and D.W. Korte. 1989. Acute oral toxicity of JA-2 solid propellant in Sprague-Dawley rats. Institute Report Number 412. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Bunton, T.E. 1990. Hepatopathology of diethylnitrosamine in the Medaka (Oryzias latipes) following short-term exposure. Toxicol. Pathol. 18(2):313-23.

Bunton, T.E. 1990. The use of aquatic bioassay in carcinogenicity testing. Lab Animal 19(5):46-7.

Cochrane, B.J., R.B. Irby, and T.W. Snell. 1990. Effects of copper and tributyltin on stress protein abundance in the rotifer Brachionus plicatilis. Comp. Biochem. Physiol. In press.

Cooper, R.C., A.W. Olivieri, R.E. Danielson, P.G. Badger, R.C. Spear, and S. Selvin. 1986. Evaluation of military field drinking water quality, Volume 5. Infectious organisms of military concern associated with consumption: Assessment of health risks, and recommendations for establishing related standards. Livermore, CA: Lawrence Livermore National Laboratory.

Coppes, V.G., C.L. Gomez, C.B. Clifford, S. Ferrais, and D.W. Korte. 1990. Toxic potential of nitroguanidine on reproduction and fertility in rats. Institute Report Number 434. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Costa, D.L., R.J. Jaskot, M. Higuchi, and D. Doerfler. 1990. Toxicity of an anthraquinone violet dye mixture following inhalation exposure and gavage. Project Order Number 87PP7808. Paper presented at Smoke/Obscurants Symposium XIV, Johns Hopkins University, 17-19 April, at Laurel, MD.

Daniels, J.I., ed. 1990. Evluation of military field-water quality, Volume 4. Health criteria and recommendations for standards, Part 2. Interim standards for selected threat agents and risks from exceeding these standards, 1-1-7-16. Project Order Number 82PP2817. Livermore CA: Lawrence Livermore National Laboratory. Symposium XIV, Johns Hopkins University, 17-19 April, at Laurel, MD.

Dawson, D.A., D.J. Fort, D.L. Newell, and J.A. Bantle. 1989. Developmental toxicity testing with FETAX: Evaluation of five validation compounds. Drug Chem. Toxicol. 12:67-75.

DeVaull, G.E., W.E. Dunn, J.C. Liljegren, and AJ. Policastro. 1989. Field measurement and model evaluation program for assessment of the environmental effects of military smokes: analysis methods and results of hexachloroethane smoke dispersion experiments conducted as part of Atterbury-87 field studies. Project Order Number 84PP4822. Argonne, IL: Argonne National Laboratory. AD A216048.

DeVaull, G.E., W.E. Dunn, J.C. Liljegren, and AJ. Policastro. 1989. Field measurement and model evaluation program for assessment of the environmental effects of military smokes: Analysis methods and results of hexachloroethane smoke dispersion experiments conducted as part of Atterbury-87 field studies. Project Order Number 84PP4822. Argonne, IL: Argonne National Laboratory. AD A216048.

Einhorn, I.N., and G. Moore. 1990. Utilization of neurophysiological protocols to characterize soldier response to irritant gases. Final report, Contract No. *DAMD17-89-C-9136. Farmington, CT: Northeast Research* Institute, Inc.

Fong, A.T., H.I. Swanson, R.H. Dashwood, D.E. Williams, J.D. Hendricks, and G.S. Bailey. 1990. Mechanisms of anti-carcinogenesis by indole-3-carbinol. Biochem. Pharmacol. 39:19-26.

Fong, A.T., H.I. Swanson, R.H. Dashwood, D.E. Williams, J.D. Hendricks, and G.S. Bailey. 1989. Mechanisms of anti-carcinogenesis by indole-3-carbinol: Studies of enzyme induction, electrophile-scavenging, and inhibition of aflatoxin B_1 Activation. Biochem. Pharmacol. 39(1):19-26.

Fort, D.J., and J.A. Bantle. N.d. Use of frog embryo teratogenesis assay-Xenopus and an exogenous metabolic activation system to evaluate the developmental toxicity of diphenylhydantoin. Fund. Appl. Toxicol. In press.

Fort, D.J., and J.A. Bantle. N.d. Analysis of the developmental toxicity of isoniazid using various exogenous metabolic activation systems with frog embryo teratogenesis assay-Xenopus (FETAX). Teratogen. Carcinog. Mutagen. In press.

Fort, D.J., B.L. James, and J.A. Bantle. 1989. The developmental toxicity of five compounds with the frog embryo teratogenesis assay-Xenopus (FETAX) and a metabolic activation system. J. Appl. Toxicol. 9:377-88.

Goldman, M., M. Nasr, N. Cone, L.S. Rosenblatt, and B.W. Wilson. 1989. Toxicity studies on agent GA: mutagenicity of Tabun (GA) in the Ames mutagenicity assay. Project Order Number 87PP7827. Davis, CA: Laboratory for Energy-Related Health Research.

Hawkins, W.E., W.W. Walker, R.M. Overstreet, J.S. Lytle, and T.F. Lytle. 1989. Carcinogenic effects of some polynuclear aromatic hydrocarbons on the Japanese medaka and guppy in waterborne exposures. Science of the Total Environment. In press.

Hawkins, W.E., W.W. Walker, J.S. Lytle, T.F. Lytle, and R.M. Overstreet. 1989. Carcinogenic effects of 7,12-dimethylbenz(a)anthracene on the guppy (Poecilia reticulata). Aquati. Toxicol. 15:63-82.

Henderson, J.D., R.J. Higgins, L. Rosenblatt, and B.W. Wilson. 1989. Toxicity studies on agent GA: Delayed neurotoxicity - acute and repeated exposures of GA (Tabun). Project Order Number 87PP7827. Davis, CA: Laboratory for Energy-Related Health Research.

Hendricks, J.D., D.N. Arbogast, and G.S. Bailey. 1990. Aroclor 1254 (PCB) enhancement of 7,12-dimethylbenz[a]anthracene (DMBA) hepatocarcinogenesis in rainbow trout. Proc. Amer. Assoc. Cancer Res. 31:122.

Hiatt, G.F.S., and D.W. Korte. 1989. Primary occular irritation potential of nitrosoguanidine in male rabbits. Institute Report Number 358. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Hiatt, G.F.S., J.D. Justus, and D.W. Korte. 1989. Primary eye irritation potential of DIGL-RP solid propellant in rabbits. Institute Report Number 408. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Hiatt, G.F.S., S.K. Sano, and D.W. Korte. 1989. Acute dermal toxicity of guanidine hydrochloride in rabbits. Institute Report Number 419. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Hiatt, G.F.S., and D.W. Korte. 1989. Primary eye irritation potential of trimethylolethane trinitrate (TMETN) in rabbits. Institute Report Number 348. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Hiatt, G.F.S., L.D. Brown, C.R. Wheeler, and D.W. Korte. 1989. Acute oral toxicity of trimethyline glycol nitrate (TEGDN) in Sprague-Dawley rats. Institute Report Number 338. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A211313.

Hiatt, G.F.S., D.F. Frost, C.R. Wheeler, and D.W. Korte. 1989. Acute oral toxicity of ball powder in ICR mice. Institute Report Number 351. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A212011.

Jaskot, R.H., D.L. Costa, M. Higuchi, and D. Doerfler. 1990. Toxicity of an anthraquinone violet dye mixture following inhalation exposure and gavage. Project Order Number 87PP7808. Poster presentation at the 29th Annual Meeting, Society of Toxicology, 12-16 February, at Miami, FL.

Jostes, R.F., Jr., L.B. Sasser, and R.J. Rausch. 1989. Toxicology studies on Lewisite and sulfur mustard agents: Genetic toxicity of Lewisite (L) in Chinese hamster ovary cells. Project Order Number 84PP4865. Richland, WA: Battelle Pacific Northwest Laboratory.

Jostes, R.F., Jr., L.B. Sasser, and R.J. Rausch. 1989. Toxicology studies on Lewisite and sulfur mustard agents: Genetic toxicity of sulfur mustard (HD) in Chinese hamster ovary cells. Project Order Number 84PP4865. Richland, WA: Battelle Pacific Northwest Laboratory.

Kawakami, T.G., N. Cone, J.D. Henderson, M. Goldman, L.S. Rosenblatt, and B.W. Wilson. 1989. Toxicity studies on agent GA: Unscheduled DNA synthesis in rat hepatocytes after exposure to Tabun (GA). Project Order Number 87PP7827. Davis, CA: Laboratory for Energy-Related Health Research.

Kawakami, T.G., N. Cone, J.D. Henderson, L.S. Rosenblatt, M. Goldman, J.C. Dacre, and B.W. Wilson. 1990. Genotoxicity of the phosphoramidate agent Tabun (GA). Project Order No. 87PP7827. The Toxicologist 10:95.

Kawakami, T.G., M. Goldman, L. Rosenblatt, and B.W. Wilson. 1989. Toxicity studies on agent GA: Mutagenicity of agent GA (Tabun) in the mouse lymphoma assay. Project Order Number 87PP7827. Davis, CA: Laboratory for Energy-Related Health Research.

Kawakami, T.G., M. Nasr, N. Cone, L. Rosenblatt, M. Goldman, and B.W. Wilson. 1989. Toxicity studies on agent GA: In vivo sister chromatid exchange assay. Project Order Number 87PP7827. Davis, CA: Laboratory for Energy-Related Health Research.

Kennedy, R.S., R.C. Wilkes, W.P. Dunlap, J.E. Fowlkes, and M.G. Smith. 1990. Characterizing soldier responses to irritant gases. Final report, Contract Number DAMD17-89-C-9135. Orlando, FL: Essex Corporation.

Lauren, D.J., P.P. Halarnkar, B.D. Hammock, and D.E. Hinton. 1989. Microsomal and cytosolic epoxide hydrolase and glutathione S-transferase activities in the gill, liver, and kidney of the rainbow trout, Salmo Gairdneri. Pharmacology 38(6):881-87.

Lee, B.C., J.D. Hendricks, and G.S. Bailey. 1989. Rare renal neoplasms in Salmo gairdneri exposed to MNNG (N-methyl-N'-nitro-N-nitrosoguanidine). Dis. Aquat. Organisms 6:105-11.

Lee, B.C., J.D. Hendricks, and G.S. Bailey. 1989. Iron resistance of hepatic lesions and nephroblastoma in rainbow trout (Salmo gairdneri) exposed to MNNG. Toxicol. Pathol. 17:474-82.

Letellier, L.C., L.D. Brown, and D.W. Korte. 1989. Dermal sensitization potential of trimethylolethane trinitrate (TMETN) in guinea pigs. Institute Report Number 346. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A211318.

Letellier, Y.C., S.K. Sano, C.R. Wheeler, and D.W. Korte. 1989. Acute oral toxicity of trimethylolethane trinitrate (TMETN) in Sprague-Dawley rats. Institute Report Number 344. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A211981.

Letellier, Y.C., L.D. Brown, and D.W. Korte. 1989. Dermal sensitization potential of DIGL-RP solid propellant in guinea pigs. Institute Report Number 411. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Letellier, Y.C., C.M. Lewis, and D.W. Korte. 1989. Acute dermal toxicity of JA-2 solid propellant in rabbits. Institute Report Number 416. Presidio of San Francisco, CA.: Letterman Army Institute of Research.

Liljegren, J.C., W.E. Dunn, G.E. DeVaull, and A.J. Policastro. 1989. Field measurement and model evaluation program for assessment of the environmental effects of military smokes: The Atterbury field study of smoke dispersion and a new stochastic dispersion model. Final report, Project Order Number 84PP4822. Argonne, IL: Argonne National Laboratory.

Malins, D.C., G.K. Ostrander, R. Haimanot, and P. Williams. 1990. A novel DNA lesion in neoplastic livers of feral fish: 2,6-diamino-4-hydroxy-5-formamidopyrimidine. Carcinogenesis 11(6):1045-47.

Mangold, K.A., Y.J. Chang, C.Z. Mathews, K. Marien, J.D. Hendricks, and G.S. Bailey. 1990. Characterization of two distinct ras genes expressed in liver tissue from rainbow trout. Proc. Amer. Assoc. Cancer Res. 31:131.

McCartney, M.L. 1990. Sensitivity analysis applied to Coburn-Forster-Kane models of carboxyhemoglobin formation. Am. Ind. Hyg. Assoc. J. 51(3):169-77.

McCarthy, J.F., and L.R. Shugart. 1990. DNA alterations and enzyme activities in Japanese medaka (Oryzias latipes) exposed to diethylnitrosamine. Neuroscience and Biobehavioral Reviews. In press.

McElroy, A.E., and J.D. Sisson. 1989. Trophic transfer of benzo[a]pyrene metabolites between benthic marine organisms. In Marine Environmental Research 28:265-69.

McMahon, G., L.J. Huber, M.J. Moore, J.J. Stegeman, and G.N. Wogan. 1990. Mutations in c-Ki-ras oncogenes in diseased livers of winter flounder from Boston Harber. Proc. Natl. Acad. Sci. 87:841-45.

Moneyhun, J.H., R.A. Jenkins, R.S. Ramsey, and T.M. Gayle. 1989. Chemical characterization and toxicologic evaluation of airborne mixtures: A system for generating mixed aerosols from a petroleum based liquid and a fine solid. Final report, Project Order Number 82PP2802, Oak Ridge, TN: Oak Ridge National Laboratory.

Morgan, E.W., C.R. Wheeler, and D.W. Korte. 1989. Acute oral toxicity of nitroguanidine in Sprague-Dawley rats. Institute Report Number 353. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., and D.W. Korte. 1989. Primary dermal irritaion potentials of nitroguanidine in female rabbits. Institute Report Number 356. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., J.D. Justus, D.F. Frost, and D.W. Korte. 1989. Dermal sensitization potential of nitroguanidine in guinea pigs. Institute Report Number 357. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., C.R. Wheeler, D.W. Korte. 1989. Acute oral toxicity of nitroguanidine in ICR mice. Institute Report Number 354. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., J.D. Justus, and D.W. Korte. 1989. Acute dermal toxicity of nitroguanidine in rabbits. Institute Report Number 355. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., D.F. Frost, C.R. Wheeler, and D.W. Korte. 1989. Acute oral toxicity of JA-2 solid propellant in ICR mice. Institute Report Number 414. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., J.D. Brogden, and D.W. Korte. 1989. Primary eye irritation potential of JA-2 solid propellant in rabbits. Institute Report Number 415. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., J.D. Justus, and D.W. Korte. 1989. Primary dermal irritation potential of JA-2 solid propellant in rabbits. Institute Report Number 413. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., C.D. Brown, and D.W. Korte. 1989. Dermal sensitization potential of JA-2 solid propellant in guinea pigs. Institute Report Number 417. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., G.F.S. Hiatt, and D.W. Korte. 1989. Acute oral toxicity of guanidine hydrochloride in mice. Institute Report Number 418. Presidio of San Francisco, CA: Letterman Army Institute of Research.

Morgan, E.W., G.F.S. Hiatt, and D.W. Korte. 1989. Primary ocular irritation potential of ball powder in male rabbits. Institute Report Number 352. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A2121080.

Morgan, E.W., L.O. Lollini, C.R. Wheeler, and D.W. Korte. 1989 Acute oral toxicity of ball powder in Sprague-Dawley rats. Institute Report Number 350. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A211317.

Morgan, E.W., and D.W. Korte. 1989. Acute dermal toxicity of trimethylolethane trinitrate (TMETN) in rabbits. Institute Report Number 347. Presidio of San Francisco, CA: Letterman Army Institute of Research. AD A211295.

Nasr, M., N. Cone, T.G. Kawakami, M. Goldman, L. Rosenblatt, and B.W. Wilson. 1988. Toxicity studies on agent GA: Mutagenicity of agent GA (Tabun) in the In Vitro cytogenetic sister chromatid exchange test. Project Order Number 87PP7827. Davis, CA: Laboratory for Energy-Related Health Research.

Nunez, O., J.D. Hendricks, and J.R. Duimstra. N.d. Ultrastructure of hepatocellular neoplasms in aflatoxin B_1 (AFB1)-initiated rainbow trout (Oncorhynchus mykiss). Toxicol. Pathol. In press.

Parker, R.M., J.D. Crowell, T.J. Bucci, J.D. Thurman, and J.C. Dacre. 1990. Thirteen week oral toxicity studies of Tabun (GA) using CD rats. Project Order Number 87PP7831. The Toxicologist 10:343.

Policastro, A.J., D.M. Maloney, W.E. Dunn, J.C. Liljegren, and G.E. DeVaull. 1989. Field measurement and model evaluation program for assessment of the environmental effects of military smokes: Evaluation of atmospheric dispersion models for fog oil smoke dispersion. Project Order Number 84PP4822. Argonne IL: Argonne National Laboratory. AD A216055.

Policastro, A.J., D.M. Maloney, W.E. Dunn, J.C. Liljegren, and G.E. DeVaull. 1989. Field measurement and model evaluation program for assessment of the environmental effects of military smokes: Annual report. Project Order Number 84PP4822. Argonne, IL: Argonne National Laboratory. AD A216054.

Pratt, J.R., and N.J. Bowers. 1990. A microcosm method for evaluating chemical effects. Tox. Assess. 5:189-205.

Pratt, J.R., and N.J. Bowers. N.d. Comparative effects of selenium in aboratory microcosms and outdoor streams. Tox. Assess. In press.

Pratt, J.R. N.d. Aquatic ecosystem responses to stress. In Aquatic Toxicology and Environmental Fate Symposium, ed. W.G. Landis and W.H. van der Schalie. Thirteenth volume, ASTM. Philadelphia, PA: American Society for Testing and Materials. In press.

Pratt, J.R., and N.J. Bowers. N.d. An artificial substratamicrocosm method for evaluating chemical effects. Tox. Assess. In press.

Sasser, L.B., J.A. Cushing, and J.C. Dacre. 1990. Dominant lethal effect of sulfur mustard in rats. Project Order Number 84PP4685. The Toxicologist 10:225.

Sasser, L.B., J.A. Cushing, D.R. Kalkwarf, and R.L. Buschbom. 1989. Toxicology studies on Lewisite and sulfur mustard agents: Modified dominant lethal study of sulfur mustard in rats. Project Order Number 84PP4865. Richland, WA: Battelle Pacific Northwest Laboratory.

Sasser, L.B., J.A. Cushing, D.R. Kalkwarf, P.W. Mellick, and R.L. Buschbom. 1989. Toxicology studies on Lewisite and sulfur mustard agents: Two-generation reproduction study of Lewisite in rats. Project Order Number 84PP4865. Richland WA: Battelle Pacific Northwest Laboratory.

Sasser, L.B., J.A. Cushing, D.R. Kalkwarf, P.W. Melick, and R.L. Buschbom. 1989. Toxicology studies on Lewisite and sulfur agents: Subchronic toxicity study of Lewisite in rats. Project Order Number 84PP4865. Richland, WA: Battelle Pacific Northwest Laboratory.

Sasser, L.B., R.A. Miller, D.R. Kalkwarf, R.L. Buschbom, and J.A. Cushing. 1989. Toxicology studies on Lewisite and sulfur mustard agents: Two-generation reproduction study of sulfur mustard (HD) in rats. Project Order Number 84PP4865. Richland, WA: Battelle Pacific Northwest Laboratory.

Sasser, L.B., R.A. Miller, D.R. Kalkwarf, R.L. Buschbom, and J.A. Cushing. 1989. Toxicology studies on Lewisite and sulfur mustard agents: Subchronic toxicity of sulfur mustard (HD) in rats. Project Order Number 84PP4865. Richland, WA: Battelle Pacific Northwest Laboratory.

Schell, Jr., J.D., and M.O. James. N.d. Glucose and sulfate conjugation of henolic compounds by the spiny lobster (Panulirus argus). J. Biochem. Toxicol. In press.

Sinclair, P.R. 1990. Development of liver cell culture system for the study of metabolism of xenobiotics. Paper presented at U.S Army Biomedical Research and Development Laboratory, 13 April, at Fort Detrick, MD.

Smolowitz, R.M., M.J. Moore, and J.J. Stegeman. 1989. Cellular distribution of cytochrome P-450E in winter flounder liver with degenerative and neoplastic disease. Marine Environ. Res. 28:441-46.

Snell, T.W., and M.A. Nacionales. 1990. Sex pheromones and mate recognition in rotifers. Comp. Biochem. Physiol. In press.

Snell, T.W., and B. Moffatt. 1990. Acute toxicity tests using rotifers. III. The effects of temperature, strain and exposure time on the sensitivity of Brachionus plicatilis. Tox. Assess. In press.

Snelson, A., P. Ase, K. Taylor, and S. Gordon. 1990. Combustion product evaluation of various charge sizes. Final report, Contract No. DAMD17-88-C-8006. Chicago, IL: IIT Research Institute.

Stewart, D.L., E.J. Sass, L.K. Fritz, and L.B. Sasser. 1989. Toxicology studies on Lewisite and sulfur mustard agents: Mutagenicity of Lewisite in the salmonella histidine reversion assay. Project Order Number 84PP4865. Richland, WA: Battelle Pacific Northwest Laboratory.

Stewart, D.L., E.J. Sass, L.K. Fritz, and L.B. Sasser. 1989. Toxicology studies on Lewisite and sulfur mustard agents: Mutagenicity of sulfur mustard in the salmonella histidine reversion assay. 1989. Project Order Number 84PP4865. Richland, WA: Battelle Pacific Northwest Laboratory.

Warner, J.S. 1990. Review of reactions of biotoxins in water (CBIAC Task 152). Final report, MIPR No. 90MM0530. Columbus, OH: Battelle Memorial Institute. AD A225908.

Yang, Jae-Ho, P.T. Kostecki, D.J. Calabrese, and L.A. Baldwin. 1990. Induction of peroxisome proliferation in rainbow trout exposed to ciprofibrate. Toxicology and Applied Pharmacology 104:476-82.

OTHER TECHNICAL EXCHANGE

The Laboratory sponsored the third annual workshop on new nonmammalian carcinogenicity assessment models on 14 and 15 August 1990. The meeting included presentations by both contractors and USABRDL staff concerning on-going research and was attended by representatives of other DOD and federal agencies, including the Army environmental office, USEPA, NCI, NIEHS and the State of Maryland.

MAJ J.T. Allen briefed attendees at the quarterly meeting of the Central Atlantic States Association of Food and Drug Officials on environmental health trends within U.S. Army preventive medicine units. The meeting was held in Hershey, PA, on 15 February 1990.

MAJ D.L. Parmer and Dr. S.A. Schaub participated in the Water R&D Master Plan meeting at Fort Belvoir, VA, on February 1990.

Dr. S.A. Schaub was committee chairman for the update of the U.S. Environmental Protection Agency's guide standard and protocol for testing point of use water purifiers. The protocol was approved as a new USEPA Surface Water Treatment Rule for emergency water requirements, in October 1989.

Dr. S.A. Schaub served as Chairman, Multiservice Contract Steering Committee on field drinking water quality standards, in FY90.

Dr. S.A. Schaub served as Chairman, American Society of Testing and Materiel (ASTM) task group D-19:24:04:04 for virus on solids. The group met at the ASTM National Water Symposium, Denver, CO, May 1990.

Dr. S.A. Schaub served as preventive medicine consultant at Brightstar 90 as a part of the Department of the Army's Water Quality Evaluation Team, during October/November 1989.

Dr. S.A. Schaub served as preventive medicine consultant for Southern Command preventive medicine services, Panama, for drinking water microbiological contamination problem, in September 1990.

Dr. S.A. Schaub was an attendee at the Water Resources Management Action Group, sponsored by Deputy Chief of Staff for Logistics at Fort Belvoir, VA, in October 1989.

MAJ J.Y. Young served as a committee member at the American Industrial Hygiene Association Aerosol Technology Committee annual meeting, American Industrial Hygiene Conference, Orlando, FL, on 16 May 1990.

Seminars Sponsored

A technical seminar entitled "The Environmental Availability and Chemical Fate of TNT in Soil-Plant Systems" was held on 11 December 1989 at U.S. Army Biomedical Research and Development Laboratory. The seminar was presented by Dr. Domonic Cataldo of Battelle Pacific Northwest Laboratory, Richland, WA.

On 13 April 1990, Dr. Peter R. Sinclair of the V.A. Medical Center, White River Junction, VT, and Darmouth Medical School, Hanover, NH, presented a technical seminar on "Development of Liver Cell Culture System for the study of Metabolism of Xenobiotics."

Significant Achievements

The Laboratory-developed mobile biomonitoring facility capable of evaluating the toxicity of water and wastewater at Army sites was used to conduct on-site evaluations of a waste effluent at an Army wastewater treatment plant and the groundwater at another Army site.

A major renovation of the in-house toxicity testing facilities was completed. The new laboratory resources will significantly improve research capabilities to develop nonmammalian toxicity assessment techniques for the assessment of Army-relevant materials.

A new modern, mobile biomonitoring facility is presently under construction which will expand our ability to perform on-site bioassessments.

BRIEFINGS TO FOREIGN AND U.S. VISITORS

12 Oct 89: Mr. Larry Whisenart, Chief, Office of Accident Prevention, Health Services Command, Fort Sam Houston, TX; and Mr. Rudy Spencer, Safety Office, U.S. Army Garrison, Fort Detrick, MD.

17 Oct 89: Defense Medical Standardization Board, Fort Detrick, MD, and Canadian businessmen.

31 Oct 89: Mr. Daniel L. Whitfield, Chief, Fire Protection Division, U.S. Army Garrison, Fort Detrick, MD.

31 Oct 89: COL Nancy Adams, Nurse Consultant, Army Nurse Corps; and COL Jean R. Miller, Nurse Consultant (IMA), Army Nurse Corps, and Dean, University of Rhode Island School of Nursing.

6 Nov 89: COL John Hughes, Mobilization Augmentee for MG Philip K. Russell, Commander, U.S. Army Medical Research and Development Command, Fort Detrick, Md.

8 Nov 89: Major General William O. Rodgers, Australian Defence Force, and LtCol Peter Warfe, Australian Medical Officer, Uniformed Services University of the Health Sciences (Escort Officer); Australia.

9 Nov 89: LTC Catherine Call, Consultant, Army Medical Department, Deployable Medical Systems.

20 Nov 89: CAPT Lewis B. Crowell, Health Services Research Coordinator, Surgeon General Branch, National Defence Headquarters, Ottawa, Ontario, Canada.

21 Nov 89: Surgeon Vice Admiral Sir Godfrey Milton-Thompson, The Surgeon General, Medical Director General (Naval), and Surgeon Captain Ramsey R. Pearson, United Kingdom Exchange Officer, U.S. Navy Medical Research Institute; United Kingdom.

6 Dec 90: LTC George L. Christenson and SSG Gary D. Gilmer, Academy of Health Sciences, U.S. Army, Fort Sam Houston, TX; LTC Leslie A. Raulin, U.S. Army Institute of Dental Research, Washington, DC; and SFC Donald V. Jussila, U.S. Army John F. Kennedy Special Warfare Center, Fort Bragg, NC.

11 Jan 90: Medical Materiel Management Course students, U.S. Army Medical Materiel Agency, Fort Detrick, MD.

18 Jan 90: COL Shirley L. Jones, Chief Nurse, Army National Guard, Office of The Army Surgeon.

6 Feb 90: Advisory Committee, U.S. Army Medical Research and Development Command, Fort Detrick, MD.

6 Feb 90: Naval Medical Materiel Support Command, Fort Detrick, MD.

9 Mar 90: CSGM John D. McGowan, U.S. Army Garrison and Fort Detrick, CSGM John L. Adams, Health Services Command, Fort Detrick, MD.

28 Mar 90: COL Robert P. Collins, President, Army Medical Department Board, Fort Sam Houston, TX.

28 Mar 90: Dr. Robert K. Mosebar, Academy of Health Sciences, U.S. Army, Fort Sam Houston, TX; and COL Frank J. Kovach, Logistics Division, Directorate of Health Care Operations, Office of The Surgeon General, Washington, DC.

29 Mar 90: LTC Frederick Gerbert, 1LT Nolan Clark, SSG Gregory Gardner, SSG Lance Guderian, and SGT Thomas Hallford, 307th Medical Battalion, 82nd Airborne, Fort Bragg, NC.

3 Apr 90: Dr. Kenneth Krieg, Executive Assistant to the Deputy Secretary of Defense; Dr. Michael Heeb, Coordinator for Laboratory Management (Research and Advanced Technology); Dr. Kenneth Gabriel, Office of the Assistant Secretary of the Army (Research, Development and Acquisition); Mr. Mark Paulson, Office of the Director, Defense Research and Engineering (Research and Advanced Technology); Mr. Tom Neuberger, Office of the Director of Naval Labs, Space and Naval Warfare Systems Command, Washington, DC; and Mr. J.F. Proctor, Naval Surface Warfare Center, Dahlgren, VA.

18 Apr 90: BG Bruce T. Miketinac, Chief, Medical Service Corps, and COL Frank J. Kovach, Logistics Division, Directorate of Health Care Operations, Office of The Surgeon General.

3 May 90: LTG Panya Yooprasert, The Surgeon General, Royal Thai Army; LTC Pol Premsmit, Medical Consultant to the Royal Thai Army; MG Suriya Phalakornkul, Director General, Armed Forces Research Institute of Medical Sciences, Bangkok; MG Thamrongrat Kaewkarn, Director, Education Division, Royal Thai Army Medical School; LTC Tantipongse, Aide to the Surgeon General; and MAJ Cheodchai Chuenchitra, Chief, Department of Immunopathology, Armed Forces Research Institute of Medical Sciences; Thailand.

11 Jun 90: MAJ George Anderson, Biomedical Information Officer, U.S. Army Materiel Command, Science and Technology Center - Europe.

2 Jul 90: Group Captain David Senior, Director, Defence Force Environmental Medical Policy, and Major Robin Gregory, Staff Officer, Health Intelligence, Division Surgeon General Headquarters; Australian Defence Force, Australia.

24 Jul 90: COL Karen Ray, Community Health Nurse, Department of Epidemiology, Walter Reed Army Institute of Research, and LTC Lee Perry, Management Fellow, Office of the Chief, Army Nurse Corps.

26 Jul 90: Medical Research Fellowship Fellows, Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, DC: MAJ Wayne B. Jonas, Family Practitioner; MAJ John S. Crowley, Flight Surgeon; MAJ Robert R. Wittler, Pediatrician; CPT Andrew T. Guertler, Emergency Medicine Physician; and MAJ Sean McDonald, Vascular Surgeon.

6 Aug 90: Medical Materiel Management Course students, U.S. Army Medical Materiel Agency, Fort Detrick, MD.

21 Aug 90: COL J.C. Rock, Commander, Air Force Occupational and Environmental Health Laboratory, CPT Allan Holck, and Mr. Roderick Harris; Brooks Air Force Base, TX.

23 Aug 90: MAJ David L. Williams, International Activities, Office of Deputy Chief of Staff, Operations, U.S. Army Medical Research and Development Command, Fort Detrick, MD.

10 Sep 90: COL Mack C. Hill, Commander, U.S. Army Medical Materiel Agency, Fort Detrick, MD.

THIS PAGE INTENTIONALLY LEFT BLANK.

ACRONYMS, ABBREVIATIONS AND SYMBOLS

AAF	2-acetylaminoflourene1
AAWS-M	Advanced Antitank Weapons System-Medium
ACIS	Army Collapsible Insect Surveillance
ADI	Allowable daily intake
AER	Aerator
AFB1	Aflatoxin B1
AMEDD	U.S. Army Medical Department
AMLO	Acquisition Management Liaison Office
ANL	Argonne National Laboratory
BAMC	Brooke Army Medical Center
BFP	Bronchopleural fistula
BR	Butyl rubber
BZ	Quinuclidinyl benzilate
C	Centigrade
Cd	Cadmium
CE	Corps of Engineers
CHO	Chinese hamster ovary
CK	Cyanogen chloride
ClO_2	Chlorine dioxide
CO	Carbon monoxide
COHb	Carboxyhemoglobin
COR	Contracting Officer's Representative
CRDEC	U.S. Army Chemical Research, Development, and Engineering Center
DDC	Digital data card
DEGDN	A propellant component, diethylene glycol dinitrate
DEHP	Di(2-ethylhexyl)phthalate
DEN	Diethylnitrosoamine
DEPMEDS	Deployable Medical Systems
DIGL-RP	A solid propellant based on DEGDN
DIMP	Diisopropyl methylphosphonate, a manufacturing by-product of the nerve agent GB (soman)
DINS	Digital Imaging Network System
DMBA	Dimethylbenz(a)-anthracene
DMMP	Dimethyl methylphosphonate
DNA	Deoxyribonucleic acid
2,4-DNT	2,4-dinitrotoluene
2,6-DNT	2,6-dinitrotoluene
DOC	Demand Oxygen Controller
DOD	Department of Defense
ECHO	Enterocytopathic human orphan
EDB	Ethylene dibromide
EOS	Ethylene Oxide Sterilizer
EROD	7-ethoxyresorufin O-deethylase
F	Fahrenheit
FETAX	Frog Embryo Teratogenicity Assay - Xenopus
FLEX	Forward Logistics Exchange
FMMDD	Field Medical Materiel Development Division
FO	Fog oil
FORSCOM	U.S. Army Forces Command
FY	Fiscal year

GA	The nerve agent tabun
GB	The nerve agent soman
GD	The nerve agent sarin
GLP	Good Laboratory Practices
GST	Glutathione S-transferase
HA	Health Advisories
HAV	Hepatitis A virus
HC	Hexachloroethane
HCl	Hydrochloric acid or hydrogen chloride
HD	The vesicant sulfur mustard
HERD	Health Effects Research Division
HF	Hydrogen fluid
HGPRT	Hypoxanthine-guanine phosphoribosyl transferase
HMX	An explosive, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
IC	Internal controls
IDE	Investigational device exemption
IITRI	Illinois Institute of Technology Research Institute
in^3	Inches cubed
IRP	Installation Restoration Program
IV	Intravenous fluid
IVS	Independent viewing station
JA-2	A solid propellant based on DEGDN
L	The vesicant lewisite
LAN	Local area network
LGP	Liquid gun propellant
lpm	Liter per minute
LSD	Laboratory Support Division
ug/dl	Microgram per deciliter
mg/m^3	Milligram per cubic meter
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
MOS	Military Occupational Specialty
MSS	Multispectral screening smoke
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NBC	Nuclear biological chemical
NCI	National Cancer Institute
NCTR	National Center for Toxicological Research
NCV	Nerve conduction velocity
NOAEL	No observable adverse effect level
NQ	A propellant component, nitroguanadine
NTE	Neurotoxic esterase
OB/OD	Open burn/open detonation
ORNL	Oak Ridge National Laboratory
oz	Ounce
PC	Personal computer
PCP	Pentachlorophenol
PDU	Pesticide Dispersal Unit
pH	Hydrogen ion concentration, negative logarithm of
PI	Principal Investigator
PPLV	Preliminary pollutant limit value
ppm	Parts per million

PSU	Pennsylvania State University
QA	Quality assurance
R&D	Research and Development
RACB	Reproductive assessment by continuous breeding
RAMB	Resources/Acquisition Management Branch
RDIC	Resuscitation Device, Individual Chemical
RDTE	Research, Development, Test and Evaluation
RDX	An explosive, hexahydro-1,3,5-trinitro-1,3,5-triazine
RfD	Reference dose
RO	Reverse osmosis
ROWPU	Reverse Osmosis Purification Unit
RP	Red phosphorus
SOF	Special Operations Forces
SVP	Steam Vacuum Pulse
TBD	To be determined
TCE	Trichlorethylene
TeCE	1,1,2,3-tetrachlorethane
TEGDN	A propellant component, triethylene glycol dinitrite
TMDE	Test, measurement, and diagnostic equipment
TNG	A propellant component, trinitroglycerin
TNT	An explosive, 2,4,6-trinitrotoluene
TOC	Total organic carbon
TROSCOM	U.S. Army Troop Support Command
UAV	Unmanned aerial vehicle
USABRDL	U.S. Army Biomedical Research and Development Laboratory
USAEHA	U.S. Army Environmental Hygiene Agency
USAMICOM	U.S. Army Missile Command
USAMMA	U.S. Army Medical Materiel Agency
USAMRDC	U.S. Army Medical Research and Development Command
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USEPA	U.S. Environmental Protection Agency
UV	Ultraviolet
V_E	Minute ventilation
V/V	Volume per volume
Vx	A nerve agent
VX	A nerve agent
WFI	Water for injection
WP	White phosphorus
WRAIR	Walter Reed Army Institute of Research
WRAMC	Walter Reed Army Medical Center
WRRS	Water Recovery and Reuse System
$ZnCl_2$	Zinc chloride

THIS PAGE INTENTIONALLY LEFT BLANK.

DISTRIBUTION

No. of Copies	
1	Commander U.S. Army Medical Research and Development Command Fort Detrick Frederick, MD 21702-5012
5	Commander U.S. Army Medical Research and Development Command ATTN: SGRD-RMI-S Fort Detrick Frederick, MD 21702-5012
1	Commander U.S. Army Medical Research and Development Command ATTN: SGRD-ZB Fort Detrick Frederick, MD 21702-5012
1	Commander U.S. Army Medical Research and Development Command ATTN: SGRD-PLA Fort Detrick Frederick, MD 21702-5012
1	Commander U.S. Army Medical Research and Development Command ATTN: SGRD-PLB Fort Detrick Frederick, MD 21702-5012
1	Commander U.S. Army Medical Research and Development Command ATTN: SGRD-PLC Fort Detrick Frederick, MD 21702-5012
1	Commander U.S. Army Medical Research and Development Command ATTN: SGRD-PLE Fort Detrick Frederick, MD 21702-5012
1	Commander Letterman Army Institute of Research Bldg. 1110 Presidio of San Francisco, CA 94129-6800

1 Director
Walter Reed Army Institute of Research
Bldg. 40
Washington, DC 20307-5100

1 Commander
U.S. Army Aeromedical Research Laboratory
Bldg. 6901
Fort Rucker, AL 36362-5292

1 Commander
U.S. Army Institute of Dental Research
Bldg. 40
Washington, DC 20307-5300

1 Commander
U.S. Army Institute of Surgical Research
Bldg. 2653
Fort Sam Houston, TX 78234-6200

1 Commander
U.S. Army Medical Materiel Development Activity
Bldg. T-622
Fort Detrick
Frederick, MD 21702-5009

1 Commander
U.S. Army Medical Materiel Development Activity
ATTN: SGRD-UMA
Bldg. T-622
Fort Detrick
Frederick, MD 21702-5009

1 Commander
U.S. Army Medical Research Institute of Chemical Defense
Bldg. E3100, Edgewood Area
Aberdeen Proving Ground, MD 21010-5425

1 Commander
U.S. Army Medical Research Institute of Infectious Diseases
Bldg. 1425
Fort Detrick
Frederick, MD 21702-5011

1 Commander
U.S. Army Research Institute of Environmental Medicine
Bldg. 52
Natick, MA 01760-5007

1 Commander
U.S. Army Medical Materiel Agency
Bldg. 1423
Fort Detrick
Frederick, MD 21702-5001

1 Commander
U.S. Army Medical Materiel Agency
ATTN: SGMMA-RM
Bldg. 1423
Fort Detrick
Frederick, MD 21702-5001

1 Commanding Officer
Naval Medical Logistics Command
Bldg. 833
Fort Detrick
Frederick, MD 21702-5015

1 Director
Defense Medical Standardization Board
Bldg. 1423
Fort Detrick
Frederick, MD 21702-5013

1 Chief
Medical Wartime Hospital Integration Office
ATTN: SGHR (COL D. Grubor)
Fort Detrick, Bldg. 819
Frederick, MD 21702-5005

1 Director
Human Engineering Laboratory
U.S. Army Laboratory Command
Aberdeen Proving Ground, MD 21005-5001

1 Commander
U.S. Army Toxic and Hazardous Materials Agency
ATTN: AMXTH-IR-D
Aberdeen Proving Ground, MD 21010-5401

1 Commander
U.S. Army Environmental Hygiene Agency
Aberdeen Proving Ground, MD 21010-5422

1 Commander
U.S. Army Laboratory Command
ATTN: AMSLC-DC
2800 Powder Mill Road
Adelphi, MD 20783-1145

1 Commanding Officer
Naval Medical Research and Development Command
National Naval Medical Center
Bethesda, MD 20814-0000

1 Commandant
Academy of Health Sciences, U.S. Army
ATTN: HSHA-CDM
Fort Sam Houston, TX 78234-6100

1 Commandant
Academy of Health Sciences, U.S. Army
ATTN: HSHA-TTC
Fort Sam Houston, TX 78234-6100

1 Commandant
Academy of Health Sciences, U.S. Army
ATTN: HSHA-UBD
Fort Sam Houston, TX 78234-6100

1 Commander
U.S. Army Health Services Command
ATTN: HSCL-P
Fort Sam Houston, TX 78234-6000

1 Commander
U.S. Army Health Services Command
ATTN: HSHN-I
Fort Sam Houston, TX 78234-6000

1 Commander
Brooke Army Medical Center
ATTN: Department of Clinical Investigations
Beach Pavilion
Fort Sam Houston, TX 78234-6200

1 HQ, HSD/YAM
Brooks Air Force Base, TX 78235-5000

1 HQ, HSD/YAO
Brooks Air Force Base, TX 78235-5000

2 HQDA (DASG-HCL-P)
5109 Leesburg Pike
Falls Church, VA 22041-3258

1 HQDA (DASG-PSP)
5109 Leesburg Pike
Falls Church, VA 22041-3258

1 HQDA (DASG-HCD-D)
5109 Leesburg Pike
Falls Church, VA 22041-3258

1 HQDA (DASG-HCZ-D)
5109 Leesburg Pike
Falls Church, VA 22041-3258

1 Chief, Army Nurse Corps
ATTN: DASG-CN, Room 623
5109 Leesburg Pike
Falls Church, VA 22041-3258

1 Nursing Consultant
ATTN: SGPS-CP-N, Room 603
5109 Leesburg Pike
Falls Church, VA 22041-3258

1 Commander
U.S. Army Materiel Command
ATTN: AMCDE
5001 Eisenhower Boulevard
Alexandria, VA 22333-0001

2 Defense Technical Information Center
ATTN: DTIC-FDAC
Alexandria, VA 22304-6145

1 Commander
U.S. Army Training and Doctrine Command
ATTN: ATCD
Fort Monroe, VA 23651-5136

1 Commander
U.S. Army Training and Doctrine Command
ATTN: ATEN-FN
Fort Monroe, VA 23651-5000

1 Chief Nurse
Office of The Surgeon (ATMD)
HQ, U.S. Army Training and Doctrine Command
Fort Monroe, VA 23651-5000

1 Director of Biological Sciences Division
Office of Naval Research
800 N. Quincy Street
Arlington, VA 22217-5000

1 U.S. Army Engineering Activity
ATTN: CENAC-OM
Capital Area - Building 203
Fort Myer, VA 22211-5050

1 HQDA (DAEN-RDM)
Washington, DC 20314-1000

1 Commander
U.S. Army Corps of Engineers
ATTN: CERD-M
20 Massachusetts Avenue, NW
Washington, DC 20314-1000

1 OUSD(A) (R&AT/E&LS)
ATTN: Director, Environmental and Life Sciences
Pentagon, Room 3D129
Washington, DC 20301-3080

1 Office of the Chief of Engineers
ATTN: DAEN-ZCF-B
Washington, DC 20314-1000

1 Headquarters
Air Force Office of Scientific Research
ATTN: Program Manager (LTC T. Jan Cerveny)
Bolling Air Force Base, Building 410
Washington, DC 20332-6448

1 Environmental Protection Agency
ATTN: Dr. Ken Sexton, Room 3100
Director, Office of Health Research
Office of Research and Development
401 M Street, SW
Washington, DC 20460

1 Environmental Protection Agency
ATTN: Dr. William Farland, Room 3700
Director, Office of Health and Environmental Assessment
Office of Research and Development
401 M Street, SW
Washington, DC 20460

1 HQ USAF/SGPA
Bolling Air Force Base, DC 20332-6188

1 Commander
U.S. Army Forces Command
ATTN: FCJ4-SME
Fort McPherson, GA 30330-6200

1 Commander
U.S. Army Forces Command
ATTN: FCEN-RD
Fort McPherson, GA 30330-6000

1 Chief
Office of The Surgeon
HQ, U.S. Army Forces Command
Fort McPherson, GA 30330-6000

1 Commander
U.S. Army John F. Kennedy Special Warfare Center
ATTN: ATSU-CG
Fort Bragg, NC 28307-5000

1 Commander
1st Special Operations Command
ATTN: ASOF-CG
Fort Bragg, NC 28307-5000

1 Commander
44th Medical Brigade
ATTN: AFVH-CG
Fort Bragg, NC 28307-5000

1 Commander
XVIII Corps
ATTN: AFZA-CG
Fort Bragg, NC 28307-5000

1 Commander
U.S. Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211

1 Commander
Army Development Employment Agency
ATTN: MODE-FDD-SB
Fort Lewis, WA 98433-5000

1 Commander
9th Infantry Division
ATTN: AFVO-CG
Fort Lewis, WA 98433-5000

1 Commander
U.S. Central Command
MacDill Air Force Base
Tampa, FL 33608-7001

1 Officer in Charge
Navy Disease Vector Ecology and Control Center
Naval Air Station, Box 43
Jacksonville, FL 32212-0043

2 23rd Air Force/CCM
Hurlburt Field, FL 32544-5000

1 1724th Special Tactics Squadron/SG
Pope Air Force Base, NC 28308-5000

1 Commander
U.S. Special Operations Command
ATTN: SOSG (COL Hughes)
McDill Air Force Base, FL 33608-6001

1 Commanding Officer
Naval Special Warfare Command
ATTN: Captain J.M. McClurkan
NAB Coronado
San Diego, CA 92155

1 Commander
U.S. Army Medical Department Activity
Fort Wainwright, AK 99703-7300

1 Commander
U.S. Army Natick Research, Development and Engineering Center
ATTN: STRNC-Z
Natick, MA 01760-5014

1 Commander
U.S. Army Troop Support Command
ATTN: AMXSO-TL
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798

1 Commander
U.S. Army Logistics Evaluation Agency
ATTN: DALO-LER
New Cumberland Army Depot
New Cumberland, PA 17070-5007

1 Headquarters
U.S. Air Force, Korea
ATTN: 7AF/SGX
APO San Francisco 96301-0019

1 Commander
121st Evacuation Hospital
ATTN: EAMC-H-ANES
APO San Francisco 96301-0017

1 USDAO-AMLO
ATTN: COL Tsoulos
American Embassy
Box 54
FPO New York 09509

2 Commanding General
Marine Corps Research, Development,
and Acquisition Command
ATTN: SSC-GP (CDR Hooten)
Washington, DC 20380-0001